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National Study to Determine Levels of Chlorinated Hydrocarbon Insecticides in Human Milk: 1975-1976 and Supplementary Report to the National Human Milk Study 1975-1976

Colorado State Univ, Fort Collins. Epidemiologic Studies Center

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16. ABSTRACT

Samples were collected during 1975-76 from 1,436 nursing women in 150 hospitals across the country. Hospitals were selected at random from every region of the U.S. to ensure that the samples would be representative of all U.S. women. Pesticide compounds or metabolites detected in mother's milk included Dieldrin, Heptachlor, Heptachlor epoxide, Oxychlordane, DDT, BHC, Lindane, and HCB. No Mirex or chlordane were found in any of the samples. The results of this study were supplied to HEW for their review and assessment.

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PREFACE

This study was conducted by the Epidemiologic Pesticides Studies Center of Colorado State University in cooperation with the Medical University of South Carolina, Mississippi State University, Michigan State Department of Health, and Utah State Department of Health; under contract number 68-01-3190, with the Epidemiologic Studies Programs, Office of Pesticides Programs, Technical Service Division, Environmental Protection Agency. The project staff included the following personnel:

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National Human Milk Study, 1975-76

Objective

The objective of this study was to estimate the distribution of selected organochlorine pesticide levels in human milk among nursing mothers giving birth in general care hospitals in the United States. Organochlorine compounds analyzed in the study included chlordane, dieldrin, heptachlor, heptachlor epoxide, Mirex, and oxychlordane.

Background

Use of the organochlorine compounds started in 1936 when DDT was first used as a moth-proofing agent (1). Because of their broad spectrum activity, low cost, and stability, the chlorinated hydrocarbon insecticides have been of great agriculture and public health importance. Through use in vector control and pest eradication programs in many countries, chlorinated hydrocarbons have aided in greatly reducing the morbidity and mortality from diseases such as malaria, yellow fever, and typhus (2). In agriculture the use of these same compounds has resulted in substantial increases in crop yields due to their efficacy against weevils, termites, wireworms, ants, cotton pests, and in protection of stored food (2). Since these compounds are important in controlling ectoparasites such as blowflies, ticks, and mites, the veterinary field has also benefited (2).

The chlorinated hydrocarbon pesticides have disadvantages as well as advantages, and the very qualities which make them beneficial have also caused many of the problems associated with their use. Perhaps the most unique quality of the organochlorine pesticides is their residual activity or persistence. For many agricultural and public health purposes this persistence is essential because it means that one application of a pesticide will result in long term protection. For example, the world-wide reduction of malaria would have been much more difficult without insecticides having this feature (2).

This same quality which has made the organochlorine pesticides so invaluable has also caused many problems. Since several of the compounds are biologically magnified in the food chain, the opportunity exists for contamination of a variety of substrates. These compounds have been detected in air, water, soil, crops, food, tissues, and milk of animals and man. It is the finding of these residues in man and animals that has caused the greatest concern, and many studies have examined various substrates to investigate type and quantities of pesticides.

Because the chlorinated hydrocarbon pesticides are lipophilic, they are readily deposited in adipose tissue, and numerous studies have been conducted on adipose biopsy material from volunteers, surgery patients, and cadavers. In 1950, Laug, Prickett, and Kunze (3) reported analyzing 35 samples of human fat and finding a DDT concentration ranging from 0 to 34 ppm. Between April 1963 and March 1964, 65 samples of human perirenal fat were analyzed by Egan et al. (4) and found to contain 0.2 to 8.5 ppm DDT, a trace to 1.0 ppm BHC, and a trace to 0.9 ppm dieldrin. Even though adipose tissue represents a good storage reservoir for pesticide residues, the difficulty in obtaining it, especially from living people, led to the utilization of other materials, particularly blood and milk. In 1972, Finklea et al. (5) in a study of 723 plasma samples from volunteers living in Charleston County, South Carolina, found p,p'-DDT and DDE almost universally, DDD in 84%, dieldrin in 63%, and PCB's in 43% of the study participants.

In the past, an indication of a person's exposure to a particular organochlorine pesticide has been documented through pesticide residues in human adipose tissue and blood. When these same pesticides were found in mother's milk, concern arose as to what effect, if any, this might have on breast fed infants. Thus, in recent years, many studies have been conducted to determine the presence and amount of chlorinated hydrocarbon pesticides in human mother's milk.

In the 1950 study by Laug _et al_. (3), 24 human milk samples from subjects who occasionally used DDT-containing household sprays were analyzed. The DDT concentrations ranged from 0 to 0.77 ppm with an average of 0.14 ppm for all samples analyzed.

During 1960 and 1961, Quinby, Armstrong, and Durham (6) collected and analyzed ten individual and four pooled samples of human milk. The individual samples contained an average of 0.08 ppm DDT and 0.04 ppm DDE in the whole milk and 2.5 ppm DDT and 1.4 ppm DDE in the lipid fraction. The pooled samples contained an average of 0.07 ppm DDT and 0.10 ppm DDE in whole milk and 3.5 ppm DDT and 4.8 ppm DDE in the lipid fraction. Multiple samples were collected from three of the donors over a period of 2 - 7 months; however, little change was observed in the excretory levels of DDT and DDE.

In 1965, Egan _et al_. (4) reported on the results of a study conducted between April 1963 and March 1964 on 19 samples of human breast milk collected from milk banks. All the samples contained traces of heptachlor epoxide, p,p'-DDE, DDT, dieldrin, and BHC. On a whole milk basis, the ranges for total DDT, total BHC, and dieldrin were 0.075-0.170 ppm (mean 0.128), 0.009-0.033 (mean 0.013), and 0.002-0.013 (mean 0.006) respectively. Based on milk fat, the values for total DDT, total BHC, and dieldrin were 0.2-8.5 ppm (mean 3.3), trace-1.0 ppm (mean 0.42), and trace-0.9 ppm (mean 0.26) respectively. In a comparison of the average pesticide residue levels in cow's milk and human milk, Egan et al (4) found that the levels in human milk exceeded those in cow's milk for every category tested.

In a study of human milk, evaporated milk, and prepared baby formulas collected from various regions of Canada during 1967-1968, Ritcey, Savarys, and McCully (7) determined mean concentrations in human milk for lindane, heptachlor epoxide, dieldrin, and total DDT to be 0.003 mg/kg, 0.003 mg/kg, 0.005 mg/kg, and 0.139 mg/kg respectively. On a fat basis these same amounts expressed as mg/kg were 0.071, 0.169, 0.284, and 5.399 respectively. In the evaporated milk and prepared baby formulas only a trace of lindane was detected; furthermore, on a fat basis, residues of heptachlor epoxide, dieldrin, and total DDT were lower than in human milk by factors ranging from 7 to 39.

Kroger, in a study of 53 human milk samples from two Pennsylvania regions found 2.40 ppm DDT, 0.16 ppm heptachlor epoxide, and 0.08 ppm lindane. Mothers who had nursed three or more babies had DDT concentrations in their milk fat below the average; whereas, the four highest concentrations were in milk fat of mothers who were nursing an infant for the first time. He theorized that the pesticide burden must decrease if a route of excretion such as lactation is provided (8).

Savage et al. reported on organochlorine pesticide residues and PCB's in human milk collected from women in rural Colorado during 1971 and 1972. The two highest levels found were p,p'-DDE which ranged from 19 to 386 ppb and p,p'-DDT which ranged from 7 to 109 ppb. Other pesticide residues included β-BHC, o,p'-DDT, dieldrin, heptachlor epoxide, and p,p'-DDD detected in ranges from a trace to 38, 13, 11, 5, and 5 ppb respectively. The PCB levels found in the milk samples ranged from 40 to 100 ppb. In addition, all milk samples contained p,p'-DDE and p,p'-DDT while 87.5% of the samples contained β-BHC and 20% contained PCB's (9).

Curley and Kimbrough studied chlorinated hydrocarbon insecticides in plasma and milk of pregnant and lactating women. Three milk samples were collected from each woman between 3 and 96 days postpartum. The concentration of the chlorinated hydrocarbon pesticides varied greatly among individual women but were within the range reported by others (10).

As can readily be seen, pesticide residues are a world-wide problem. They can be detected in virtually all animal tissues even in remote regions far removed from areas of advanced civilization. A good example of this was a study done in New Guinea in 1970 by Hornabrook et al. (11). Seventy-four milk samples were collected from women voluntarily seeking assistance from hospitals or child and maternal welfare health clinics. For the most part these people were leading a traditional life; however, most of them had been exposed to varying degrees of Western influence including agricultural and malaria spraying. In Sepik, a community which had had malaria control at 6 month intervals since 1962, levels of p,p'-DDE, p,p'-DDT, p,p'-DDD, and o,p'-DDT in parts per billion were 95.9, 181.0, 5.47, and 8.24 respectively. In Goroka, which was sprayed first, 6-8 months prior to the time the samples were collected in 1969, levels for the above materials were 29.0, 68.3, 4.37, and 7.02 ppb respectively. In Saidor and KarKar Island, both of which had long Western contact but no regular or planned malaria control program and only minimal agricultural spraying, values for p,p'-DDE and p,p'-DDT were much lower, being 1.66 ppb each for KarKar Island and 2.10 ppb and 1.54 ppb respectively for Saidor. The last two communities, Labogai and Okapa, had no malaria control but had had European contact for about twenty years. Levels of p,p'-DDE and p,p'-DDT in Labogai were 10.25 ppb and 38.40 ppb while in Okapa the levels were 6.69 ppb and 7.65 ppb respectively.

Newton and Greene also conducted a study on organochlorine pesticide levels in human milk in Victoria, Australia in 1970 (12). Thirty-nine rural and twenty-eight urban mothers were chosen. All the samples contained DDT, DDE, and HCB. In addition, twenty-nine of the samples contained dieldrin (mean 0.006 ppm), 12 contained DDD (mean 0.007 ppm), and 3 contained both dieldrin and DDD. The total DDT residue averaged 0.139 ppm for rural and 0.145 ppm for urban donors.

Milk samples from 22 nursing mothers living in the Perth, Western Australia area were analyzed for organochlorine residues (13). The following residues were detected in the milk samples (composite of 22 samples): DDE, 0.080 ppm; DDT, 0.015 ppm; dieldrin, 0.005 ppm; and HCB, 0.025 ppm. Other studies of organochlorine pesticide levels in milk have included: Germany - Acker and Schulte 1971 (14), Acker and Schulte, 1970 (15), Engst and Knoll, 1972 (16); Sweden - Westoo and Noren, 1972 (17); the U.S.A. - Dyment et al., 1971 (18), Hagyard et al., 1973 (19); Holland - Tuinstra, 1971 (20); Poland - Kontek et al., 1971 (21); Belgium - Heyndrickx and Maes, 1969 (22); Russia - Gracheva, 1970 (23); and Japan - Takeda et al., (24), and Nishimoto et al., 1973 (25).

Concern over the levels of pesticide residues in man has led to extensive food monitoring programs and establishment of maximum limits of pesticide concentrations permissible in many foods. The World Health Organization has set a limit of 0.05 ppm (1.25 ppm in milk fat) for total DDT in cow's milk (8) and a maximum admissible daily intake (ADI) of DDT of 0.01 mg/kg body weight (26). Thus, if a 4 kg infant drinks 650 ml of milk per day, the milk must contain less than 0.06 ppm total DDT in order not to exceed the ADI of 0.04/mg DDT/day (26).

Even though there has been no demonstrated damage to breast fed infants from DDT, monitoring of human milk continues with some interesting findings. In a study by Wilson in 1973 (26), it was learned that 39% of the women sampled had used pesticides in the home or garden; however, no statistically significant difference in levels of total DDT could be demonstrated. On the other hand, those people who employed a professional exterminator rather than applying pesticides themselves did have lower concentrations of total DDT. No significant correlation could be found in a comparison between DDT levels in milk and the number of days per week that meat or fish was eaten by milk donors. However, it was discovered that those using margarine rather than butter had higher levels of DDT. Wilson (26) attributed this to the fact that margarine is made largely of cottonseed oil, and DDT had been used extensively in the cotton industry. Wilson's study also found that residues were significantly higher in the hind milk (milk collected when the breast was nearly empty) than in the fore milk (milk collected when the breast was full), and that these concentrations tend to be lower in milk of older mothers.

Although much milk research has been done, as evidenced from this literature review, in general the populations studied have been small or restricted in geographical location. Furthermore, previous studies have been concerned primarily with the pesticide DDT. The study reported herein was initiated to investigate a wider spectrum of pesticides from a large segment of the nursing mother population. By using a representative sample, such variables as age, area of residence, number of children nursed, and social habits could be considered as possible factors relating to the residue levels found.

Plan of Study

Population to be Sampled: Ideally, to select the population to be sampled, a continuously updated list of nursing mothers would have been needed for the period of the study. From this list a sample could have been selected according to some procedure, and from the sample, the number of mothers with organochlorine pesticides in their milk and the level of organochlorine pesticides in the milk could have been estimated. Since a national list of nursing mothers was not available, hospitals were used as the primary sampling units. A sample was selected from a list of the general hospitals in the United States, according to the sampling scheme described below. It was useful to think of each hospital (the primary sampling unit) as representing a cluster of nursing mothers recently delivering in that hospital; and once a hospital was selected a subsample of nursing mothers was developed.

The Sampling Frame: The population to be sampled consisted of the approximately 783 hospitals participating in the Acute Pesticide Poisoning Study which had nursery facilities (27). These hospitals were randomly selected from the list of approximately 7,000 general hospitals (31) according to the protocol for "Field Studies System for Characterization of Acute Pesticide Poisonings". Each general hospital was classified according to pesticide usage levels (geographic area), state, and geographic region. This hierarchical classification scheme constituted the sampling frame.

Selection of the Sample: Within each pesticide usage level within each of the five geographic regions, the general hospitals with nursery facilities were stratified according to the number of births in the hospitals for the 1973 calendar year. The stratification plan is shown in the following diagram:

Region (e.g. Southeast)

Usage Level

Low High

No. Births (Low)		**No. Births** (High)	
$\le B_1{}^L/\text{yr.}$	$\begin{cases}\text{Hospital } 1\\ \vdots\\ \text{Hospital } N_1^L\end{cases}$	$\le B_1{}^H/\text{yr.}$	$\begin{cases}\text{Hospital } 1\\ \vdots\\ \text{Hospital } N_1^H\end{cases}$
$\vdots$	$\vdots$	$\vdots$	$\vdots$
$\le B_K{}^L/\text{yr.}$	$\begin{cases}\text{Hospital } 1\\ \vdots\\ \text{Hospital } N_K^L\end{cases}$	$\le B_K{}^H/\text{yr.}$	$\begin{cases}\text{Hospital } 1\\ \vdots\\ \text{Hospital } N_K^H\end{cases}$

The stratum boundaries, i.e., B_1^L, $B_2^L, \ldots,$ B_K^L, and the allocation of the number of hospitals sampled within each area were determined on the basis of the actual distribution of the number of hospitals included in the sampling frame. Within each pesticide usage level within each geographic region, 20 percent of the hospitals included in the sampling frame were selected. Once the number of hospitals to be sampled in the usage level of the region was determined, the stratum boundaries were determined in the following manner. The hospitals in the sampling frame were ranked according to births and partitioned into K quantiles, where K is the number of hospitals to be selected. Each of these quantiles contained approximately the same number of hospitals.

One hospital was randomly selected within each of these quantiles with the restriction that each state within the region received no more than 30 percent and no less than 10 percent of the hospitals in the sample. This procedure ensured that states with a large number of hospitals were not over represented and that states with a smaller number of hospitals had an enhanced chance of being represented. This sampling procedure produced a sample of 150 general hospitals for the country (see Appendix I).

The proportional allocations of mothers to be sampled in each hospital was based on the 1973 number of births in the sampled hospitals and was constrained so that a minimum of 5 and a maximum of 100 nursing mothers would have been interviewed in each hospital sampled. It should be noted that this allocation procedure implicitly assumed that the proportion of nursing mothers was constant from hospital to hospital. As an example of the sample allocation, if the number of births in a hospital was one percent of the total of all births among the sampled hospitals, then one percent of the 1,600 milk samples—that is, 16 samples—were drawn from that hospital. From a specified point in time, nursing mothers who agreed to participate in the study were selected until the quota for the participating hospital was filled. If for some reason an original study participant dropped out of the study, the next willing participant was sampled.

Data Acquisition and Scope of Inference: After a hospital was selected, the hospital administrator and/or chief of staff was contacted. During this contact, the number of women to be included in the study was discussed. If the field epidemiologist did not collect the samples, a hospital nurse or La Leche League leader was recruited and trained to follow up on sample collection and subsequent shipment of the samples to the laboratory for analysis (see Appendix A).

The first objective was to identify all cases where the mother nursed the baby. Then, as previously stated, starting at a given point in time, nursing mothers who agreed to participate in the study were selected until the quota for the participating hospital was filled. This straightforward approach in selection of study participants meant that the field epidemiologist, nurse, or La Leche League leader selected the nursing mother, instructed her in the procedure to be followed for milk collection, and completed the data information card. The data card included name-age-occupation-race of each study participant, number of siblings, occupation, and highest school year completed by household head. In addition, information was collected to determine if anyone living in the household was employed by a pesticide related industry (see Appendix B).

To gain more knowledge regarding the pesticide usage patterns of the participants, a stratified random sample of 10 percent of the participating nursing mothers was recontacted. Five percent of the participants with the highest levels of organochlorine pesticides and five percent of the participants with low levels were recontacted by telephone by a field epidemiologist to determine their patterns of pesticide usage. The pesticides usage form in Appendix H was completed for each participant.

The allocation of nursing mothers to be sampled should have been based on the distribution of nursing mothers in 1975 within the sampled hospitals. This, of course, was not possible since the study was to be conducted during 1975. An alternative method might have been to base the allocation on the distribution of nursing mothers for a previous year. However, even this information was not available.

Since information on the distribution of nursing mothers was not available for a previous year, sample allocation was based on births in the sampled hospitals in 1973. Allocation of the sample based on 1973 births was not always possible. For example, several cases occurred where the number of births in 1975 was much smaller than the number of births in 1973. Additionally, the proportion of nursing mothers appeared to be subject to wide variation from hospital to hospital. Thus, in several hospitals the required sample could not be obtained within the time constraints of the study. For example, use of 1973 information might require a sample of 50 nursing mothers from a particular hospital. Upon contacting the hospital, it might have been discovered that only 10 mothers who intended to nurse would have delivered in the hospital during 1975.

In this sampling scheme, once a sample was selected, every effort was made to obtain information on selected individuals. In case a hospital administrator refused to cooperate, an effort was made to contact several local doctors to obtain names of nursing mothers who had recently delivered in the selected hospitals. Ideally, the demographic characteristics of the women contacted in this manner should have been equivalent to the composition of all nursing mothers in the target hospital. With the lack of available information on nursing mothers, this of course was not verifiable.

In the event of refusal by hospital administrators, another approach was to contact the La Leche League to obtain nursing women who had delivered in the target hospital. If membership in the La Leche League was limited to women of one socio-economic class in each community, this would have introduced bias. A preliminary examination of the data indicated that the socioeconomic class of the members of the League was not constant across the country. Although the national membership of the League appeared to include all facets of society, this might not have been true of a particular chapter.

If the required number of nursing mothers was obtained by either of the above methods, the hospital was assumed contacted. When local doctors did not cooperate, a La Leche League was not present in the area, or members of the League did not use the target hospital for delivery, a substitute hospital (or hospitals) was selected. Substitutions also were made when the number of mothers nursing was so small, thereby requiring a prohibitive period of time to obtain the required sample size. This small number of nursing mothers generally was due to a large negative discrepency in the number of births in 1975 compared to 1973 and/or due to a smaller than predicted proportion of nursing mothers in a particular hospital.

Hospital substitutions were obtained in the following manner. All hospitals in the desired usage level of the milk region having approximately the same number of births as the target hospital which had cooperated with the Center on previous occasions were listed. An alternate hospital was selected at random from this list. If no hospitals equivalent in size to the target hospital were available, several hospitals were randomly selected from this list, making their total number of births approximately equal to the number of births in the target hospital in 1973. The sample then was allocated proportionately among these alternate hospitals.

Pesticides and metabolites analyzed in this study included: dieldrin, chlordane, heptachlor, heptachlor epoxide, Mirex, and oxychlordane. When samples included a large volume of milk, the excess milk was frozen and stored for future analysis as might be requested.

Field Epidemiology

To evaluate the quality of the field work performed by the field contact person, 10 percent of the participants were rechecked by telephone. Rechecking served to monitor the thoroughness of the field staff in obtaining pertinent data from the study participants. The verification of data was extremely important since the hospital nurses or La Leche League leaders who participated in the study had received on-site training provided by the field epidemiologist.

Quality control of the data generated by this study was provided by the Colorado Epidemiologic Studies Program Center staff who edited and coded the completed data sheets.

Quality control of the study was enhanced to a greater degree by holding training courses for the field epidemiologists and chemists. The training course for the field epidemiologists was held April 8th and 9th, 1975, at Colorado State University. The purpose of the course was to acquaint the epidemiologists with the objective and design of the study, and to introduce techniques to be used in contacting the selected hospital administrators, nurses, La Leche League leaders, and nursing mothers. Field staff also was instructed in the proper completion of the study participant information card, and in sample collection, packaging, storage, shipping, and labeling. Several work and discussion sessions were held during the two day period to enable the participants to encounter as many hypothetical problems as possible so as to be better prepared to handle similar problems in the field. A copy of the training course is presented as Appendix C.

A similar training course was held April 22 and 23, 1975, at Colorado State University not only to acquaint the analytical chemists with the study, but also to introduce the analytical methods to be used in the evaluation of the samples collected. Topics covered during the course included: study design; sample collection, packaging, storage, handling, shipping, and labeling; sample analysis; instrumentation; analytical quality control; qualitative aspects of study; logging in of samples; and the completion of pesticide residue reporting forms. The chemists also were required to complete an actual milk extraction and analysis in the laboratory on the last day of the training course. A copy of the training course is presented as Appendix D.

Age:

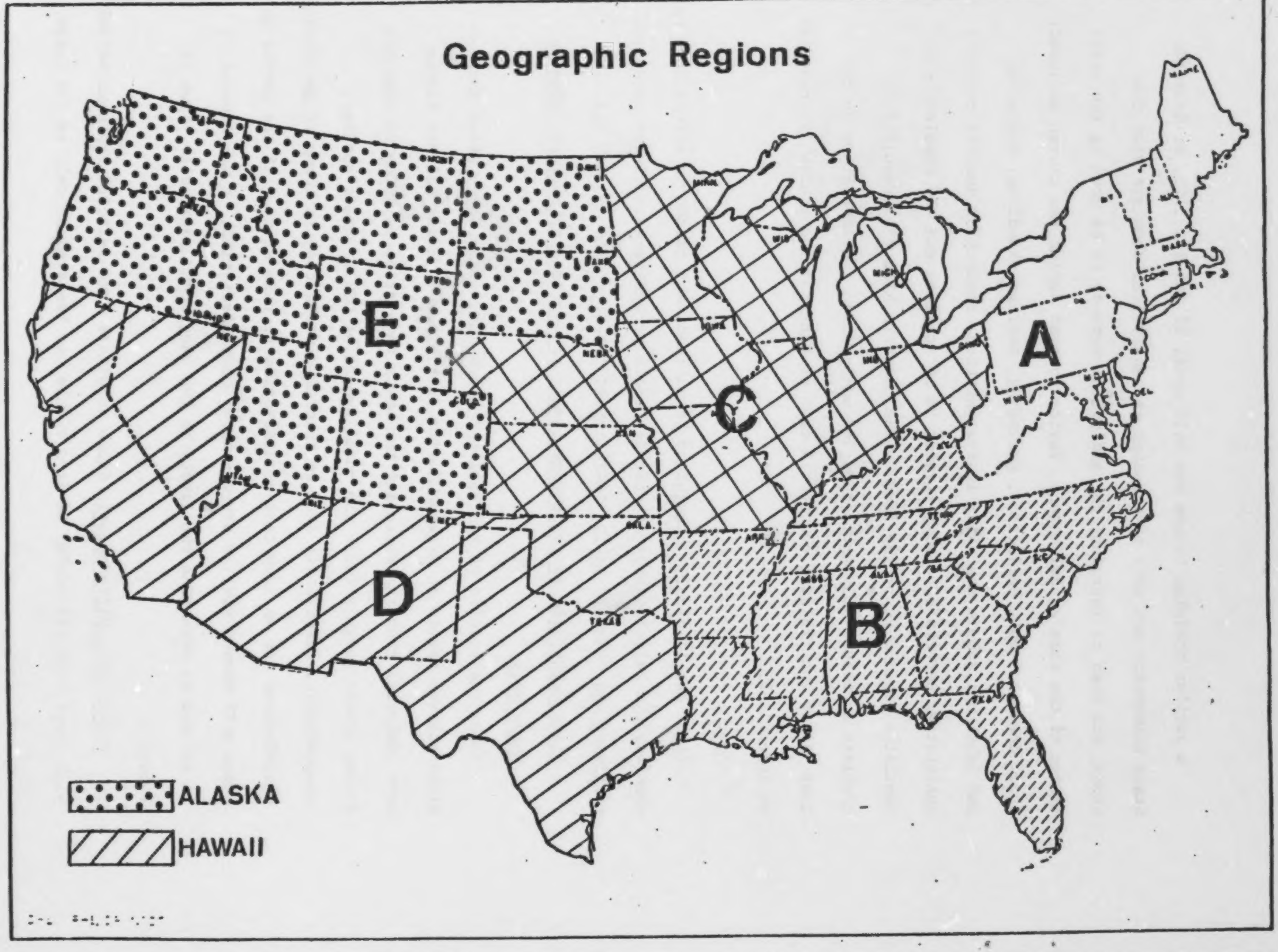
Since age is usually thought to be an important factor in epidemiological studies, the relationships of storage levels by age were tabulated using the following age groups: 15-19, 20-24, 25-29, 30-34, 35-39, 40-44, and >45.

Place Relationships to Storage Levels of Organochlorine Pesticides in Human Milk:

Since the results of the National Human Monitoring Study which determined storage levels of organochlorine pesticides in human adipose tissue have indicated that the white and non-white population residing in southern states stored roughly twice the total amount of DDT as their northern counterparts, descriptive data on spatial distribution in terms of geographic distribution was an important consideration in this study. If the levels in human milk showed similar storage level characteristics, it was imperative to attempt to determine the levels by the geographic regions as shown in Figure 1.

Urban-rural Differences: Since hospitals were selected representatively with respect to the number of live births per hospital as well as the usage

Figure 1.



Geographic Regions

A
B
C
D
E
ALASKA
HAWAII

of pesticides in the surrounding area, data were collected to determine urban-rural differences. In the United States Census, the population was classified by residence as urban, rural-farm, and rural non-farm according to land use and population density. Since the hospitals in this study also served rural and urban areas, it was anticipated that a pattern of organochlorine pesticide levels could be developed to depict their occurrence in urban and rural settings.

Statistical Analyses of the Data

Analyses of the data used various chi-square tests to determine variations in pesticide excretion by compound, geographic region, race, age, and usage patterns. Differences in residue levels by socioeconomic area were also examined using the Hollingshead Index to define the socioeconomic levels (30). Since the composition of the population of nursing mothers varies from time to time, the statistical inferences to be drawn from these data were made relative to the observed sample. However, the sample itself was the best available estimate of the characteristics of the population of nursing mothers.

Sample Analysis

Milk samples were manually expressed by participants into small glass bottles equipped with plastic screw caps and teflon liners. The filled bottles were kept frozen until time of extraction.

Analytical standards for the chlorinated pesticides were obtained from the pesticide repository of the United States Environmental Protection Agency Laboratory, Research Triangle Park, North Carolina. Solvents were redistilled in glass prior to use. The evaluation, storage, activation, and use of Florisil followed the recommended procedures described in the "Manual of Analytical Methods" (28).

The extraction procedure used was a modification of those described by Guiffrida et al. (29) and Curley and Kimbrough (10). The procedure consists of three parts: 1) isolating the fat from the milk, 2) extracting the chlorinated hydrocarbons from the fat, and 3) cleaning up the extract.

Whole milk was weighed into clean glass centrifuge bottles. Glass wool was added to adhere to the coarse precipitate of the milk solids. After addition of 100 ml of acetone, the sample was shaken manually for one minute and centrifuged for two minutes. The acetone layer then was transferred to a 1-liter separatory funnel. The extraction procedure was repeated an additional three times with equal volumes of 25 ml of acetone each time. All four acetone extractions were combined in the 1-liter separatory funnel.

Twenty-five milliliters of n-hexane were added to the coarse precipitate of milk solids. The resultant solution was shaken, centrifuged, decanted, and combined with the acetone extracts in the 1-liter separatory funnel. After repeating this procedure, volumes of 125 ml of 2 percent sodium sulfate solution and 50 ml n-hexane were added to the acetone and hexane extracts. The separatory funnel was shaken manually for one minute and the lower aqueous layer was discarded. The 2 percent sodium sulfate washing was repeated, the lower aqueous layer was discarded, and the n-hexane layer was poured into a 500 ml concentrator flask. At this point the extract was partitioned between acetonitrile and hexane to reduce the fatty material in the extract. The sample extract was taken through the Florisil procedure as described in the "Manual of Analytical Methods" (28).

Primary identification and quantification of the pesticides were accomplished on a MicroTek 220 Gas Chromatograph equipped with Ni^{63} and H^3 electron capture detectors. Two columns each having different resolution characteristics, were utilized on all samples. Instrument parameters were as follows:

Columns: (A) Borosilicate glass, 6' x ¼", packed with 1.5% OV-17 and 1.95% OV-210 on Gas Chrom Q 100-120 mesh Applied Science

(B) Borosilicate glass, 6' x ¼", packed with 4% SE-30 and 6% OV-210 on Gas Chrom Q 100-120 mesh Applied Science

Detectors: (A) Electron capture, having 14.5 mc Ni^{63} and 130 mc H^{3} as the ionizing sources.

Temperature: (A) Electron capture

Injector 245°C, Ni^{63}; H^{3}
Column 200°C, Ni^{63}; H^{3}
Detector 300°C, Ni^{63}; 210°C, H^{3}

Carrier Gas: High purified nitrogen

Flow Rates: 60 cc/min for Column A
100 cc/min for Column B

The detection limit was calculated using the following formula:

$$D.L. = \frac{(X)\ (Y)}{Z}$$

Where X is equal to one-half the concentration of the routine Gas Chromatographic standards, Y is equal to the microliters of standard injected and Z is equal to the milligrams of sample injected. All samples were placed on two different columns for electron capture detection. In order to further enhance the qualitative aspects of the study, the 6 percent and 15 percent Florisil fractions were pooled separately for added confirmation using G.C./M.S. techniques.

The sensitivity limits for the Human Milk Study were: dieldrin, 1 ppb; heptachlor, 1.0 ppb; heptachlor epoxide, 1.0 ppb; chlordane, 30 ppb; Mirex, 30 ppb; and oxychlordane, 1.0 ppb. Sensitivity limit was defined as a gas chromatographic peak that will give at least 50 percent full scale deflection from injecting 100 picograms of aldrin with a signal to noise level not exceeding 2 percent full scale deflection at an attenuation of 10 by 16. Detectable values that were below the accepted detection limit were recorded as trace values.

Lipid Determination for the Human Milk Procedure

To ascertain the lipid content, the procedure outlined below was followed. Although this procedure does not adhere exactly to those techniques found in Isolation, Analysis and Identification of Lipids (32), it does give some quantitative indication of the percent lipid in the human milk sample.

The lipid determination used in the analysis of human milk analytical procedure was as follows:

The volume in the 250 ml concentrator flask was reduced to approximately 10 ml, transferred quantitatively to a 100 ml volumetric flask, and brought to volume with n-hexane.

A volume of 20 ml was pipetted from the 100 ml volumetric flask and poured into a clean, dry 50 ml beaker. The 20 ml volume represented 1/5 of the original sample size and was placed into a 37° C oven overnight for lipid determination.

The beaker should be weighed before adding the 20 ml of sample and again after the hexane has evaporated, leaving the lipid in the beaker. The difference in weight was the weight of the lipid. The weight of the lipid was then divided by the weight of the sample in the 20 ml portion to give percent lipid. If an initial sample extract weight deviated from 7.0 grams of milk, the final extract volume, before E.C.G.C. determination was adjusted to stay within the stated detection limits. In a 7.0 gm sample, the 20 ml portion contained 1.4 gm for lipid determination, and the remaining 5.6 gm was used for pesticide analysis. Thus, the majority of the sample was injected on the gas chromatograph at the sample concentration of 5.6 mg.

Example:

Lipid + Beaker:	27.3937 gm
Dry Beaker:	27.3652 gm
Lipid	0.0285 gm

Total Sample = 7.0 gm
Sample in 20 ml = 1.4 gm
0.0285 gm/1.4 gm x 100 = 2.04% lipid

PPB:

Original Sample = 7.0 gm
Final Extract Volume = 5.0 ml
Concentration of Final Extract = 1.12 mg/µl
1.12 mg/µl x 5.0 µl injection = 5.6 mg sample injected
Sample Peak Height (mm) x pg/mm from Standard = number pg in sample peak
Number pg in sample peak/5.6 mg sample = ppb

QUALITY CONTROL

The laboratory quality control program for the human milk study was divided into two classifications, intralaboratory and interlaboratory. The Intralaboratory control program was designed to assist a single laboratory in improving the accuracy and precision of data produced by its personnel through provision of systematic guidelines for analytical methodology and techniques. The purpose of the intralaboratory control program was to provide a continuing systematic, in-house regimen intended to ensure the production of analytical data of high validity. The objectives of this program were: 1) to provide a measure of the precision of the analytical method used, 2) to maintain a continuing assessment of the accuracy and precision of analysis within the laboratory group, and 3) to identify problems with the methodology. The intralaboratory program provided a continuing measurement of the performance capability of each analyst.

The approach of the intralaboratory control program was for each laboratory to prepare its own spiked reference material (SRM) with the assistance of the coordinating laboratory. Human milk samples were then divided into two equal portions. One portion served as substrate for the SRM, the other portion for the control sample. The frequency of SRM analysis was at least 10 percent. For example, if thirty samples were analyzed per week, one corresponding standard spike sample was analyzed for each nine samples, or a total of three standard samples. The standard (SRM) was carried through the analysis in parallel with a group of routine samples, with no special care or treatment. In laboratories where more than one chemist performed the routine analysis of the samples, each individual analyzed separate SRM samples.

In addition to recording numerical results of each analysis of an internal check sample, each analyst or team constructed a Quality Control Chart or Curve on which the results of each analysis were plotted to provide graphic assessment of accuracy and precision for the analysis of each substrate and detection of erroneous data. Furthermore, recovery rates were established and compared to those of previous tests by spiking separate milk samples with known amounts of pesticides and analyzing these spiked samples utilizing the described procedures.

The Interlaboratory control program involved the analysis of uniform samples by the four cooperating laboratories in order to assess the continuing capability and relative performance of each. The objectives of the interlaboratory program were: 1) to provide a measure of the precision and accuracy of the analytical method which was analyzed routinely by the participating laboratories, 2) to measure the precision and accuracy of results between laboratories, and 3) to attempt to identify problems in the analytical methodology.

The interlaboratory program included the analyses of an interlaboratory check sample by all participants. The coordinating laboratory provided uniform, standard analytical methodology, as well as informal on-the-job training for these specified requirements. On-the-job training was in the form of a chemist training course held at the coordinating laboratory. Assistance relating to analytical methodology was also handled by telephone and mail. When the completed reporting forms from the participating laboratories were received in the coordinating laboratory, the quantitative results were entered on a Summary of Results sheet and statistically analyzed. A relative performance or ranking table was prepared, establishing a numerical ranking value of each laboratory. The statistical terms and calculations and their use was exactly the same method used by the quality control program of the EPA Pesticides and Toxic Substances Effects Laboratory in North Carolina. The training course agenda, sample of instruction letter, and interlaboratory check sample results are included in Appendices D and E of this report.

In the course of the interlaboratory quality control program, it was found that one of the participating laboratories was out of control. Following a strict review of their data, it was deemed necessary to either reanalyze 221 samples or to review the gas chromatograms. Unfortunately, these tracings had been discarded by the participating laboratory; and only 48 of the 221 samples had sufficient volumes of milk for reanalysis. Time constraints prevented the collection of the needed 173 replacements. Hence the results in this report are based on 1436 milk samples instead of the 1609 originally obtained.

RESULTS

The composition of the sample of 1436 mothers by region and age, race, and occupation is given in Tables 1, 2, and 3 respectively. The percentages given represent the proportion of mothers in a region in a given classification. For example, of the 233 mothers sampled in region A (Northeast), 40 or 17.2 percent were between 20 and 24 years old, 5 or 2.1 percent were black, and 146 or 62.7 percent were housewives.

Table 1. THE NUMBER AND PERCENT OF STUDY PARTICIPANTS BY U.S. REGION AND AGE
Human Milk Study 1975

Region	Age						Total
	Un-coded	15-19	20-24	25-29	30-34	35+	
A (NE)							
N	1	6	40	103	61	22	233
%	0.4	2.6	17.2	44.2	26.2	9.4	100.0
B (SE)							
N	1	20	85	120	49	13	288
%	0.3	7.0	29.5	41.7	17.0	4.5	100.0
C (Midwest)							
N	2	23	132	163	47	11	378
%	0.5	6.1	34.9	43.1	12.5	2.9	100.0
D (SW)							
N	2	16	99	162	89	20	388
%	0.5	4.1	25.5	41.8	22.9	5.2	100.0
E (NW)							
N	4	10	54	58	19	4	149
%	2.7	6.7	36.2	38.9	12.8	2.7	100.0
Total	10	75	410	606	265	70	1436

Table 2. THE NUMBER AND PERCENT OF STUDY PARTICIPANTS BY U.S. REGION AND RACE

Human Milk Study 1975

Region	Race					Total
	White	Black	Am. Indian	Mexican Am.	Other *	
A (NE)						
N	212	5	0	0	16	233
%	91.0	2.1	0	0	6.9	100.0
B (SE)						
N	247	21	2	1	17	288
%	85.8	7.3	0.7	0.3	5.9	100.0
C (Midwest)						
N	326	3	2	1	46	378
%	86.2	0.8	0.5	0.3	12.2	100.0
D (SW)						
N	310	4	5	36	33	388
%	79.9	1.0	1.3	9.3	8.5	100.0
E (NW)						
N	115	4	8	4	18	149
%	77.2	2.7	5.4	2.7	12.0	100.0
Total	1210	37	17	42	130	1436

* Other includes unknown as well as other races.

Table 3. THE NUMBER AND PERCENT OF STUDY PARTICIPANTS BY U.S. REGION AND MOTHER'S OCCUPATION

Human Milk Study 1975

Region	Occupation				Total
	Unknown	Laborer	Professional	Housewife	
A (NE)					
N	1	5	81	146	233
%	0.4	2.1	34.8	62.7	100.0
B (SE)					
N	0	15	55	218	288
%	0	5.2	19.1	75.7	100.0
C (Midwest)					
N	2	17	101	258	378
%	0.5	4.5	26.7	68.3	100.0
D (SW)					
N	5	8	106	269	388
%	1.3	2.1	27.3	69.3	100.0
E (NW)					
N	2	5	35	107	149
%	1.3	3.4	23.5	71.8	100.0
Total	10	50	378	998	1436

Previous studies (26) have shown that variations in the levels of pesticides may occur in the fore and hind milk, and that these variations are due primarily to the fat content of the sample at the time of collection. Because such variations might occur, in order to minimize this factor the results of this study are reported in parts per billion (ppb) of each pesticide calculated on a fat adjusted basis. As described in the methodology section, the sensitivity levels for dieldrin, heptachlor, heptachlor epoxide, and oxychlordane was 1.0 ppb and for Mirex and chlordane it was 30 ppb. These levels are considered as the lowest permissible concentration at which the analyst can accurately quantitate the chemical. In many samples the presence of a pesticide could be detected but not quantitated. In such instances a value of trace was reported to indicate the presence of the compound in the sample. Since accurate numerical values can not be assigned to trace findings, these values could not be adjusted to the fat content of the sample and thus have been reported only as showing a trace amount in the statistical analysis. It is doubtful that omission of these values has biased the results, but it is certainly suggestive enough to warrant consideration as a follow up study.

Results of analyses on dieldrin, chlordane, oxychlordane, heptachlor, heptachlor epoxide, and Mirex are reported in this study. Since dieldrin has been used extensively for the control of a variety of agricultural insects and forest pests in the United States since 1952, it is not surprising that dieldrin was found in over 80 percent of all the samples collected. Chlordane or octachlorotetrahydromethanoindane is readily absorbed through the skin and other portals. Because chlordane breaks down rapidly it was not found in any of the 1436 milk samples, but its metabolite oxychlordane has been frequently found in milk by other investigators, as well as in this study. Although heptachlor has been used in the United States during the past twenty years, including extensive use in the past for control of the cotton boll weevil, it was recovered in less than two percent of the samples. On the other hand, its metabolite, heptachlor epoxide,was found in 63.1 percent of the samples.

Since Mirex was patented by Allied Chemical Company in 1955, it has been used extensively for fire ant control in the southeastern United States. Because many urban areas had been aerially treated with Mirex during the fire ant control program, it was anticipated that some mothers might be excreting Mirex in their milk. Mirex was not positively identified in any of the 1436 samples collected throughout the United States.

The range and mean levels of dieldrin, oxychlordane, and heptachlor epoxide on a fat adjusted basis, by each of the five regions, are shown in Figures 2 through 4. Comparisons by region of the number of positive samples, ranges, and mean levels for each pesticide on a fat adjusted basis are found in Tables 4 through 6.

According to Table 4, there were over 250 samples positive for dieldrin in the Southeast, Southwest, and Midwest. The lowest number of samples positive for dieldrin, 125, was collected from the Northwest. The range of all samples positive for dieldrin on a fat adjusted basis was from 13.60 to 12,300.00 ppb. The highest level was found in a sample collected in the Southeast. The mean level of dieldrin was highest in the Southeast, followed by the Southwest, Midwest, Northwest, and Northeast.

According to Table 5, there were over 200 samples positive for heptachlor epoxide in the Southeast and Midwest. The lowest number of samples positive for heptachlor epoxide, 91, was from the Northwest. The range of all samples positive for heptachlor epoxide on a fat adjusted basis was from 15.24 to 2,050.00 ppb. The highest level was found in a sample collected from the Southeast. The mean level of heptachlor epoxide on a fat adjusted basis was highest in the Southeast, followed by the Midwest, Southwest, Northeast, and Northwest.

According to Table 6, there were over 200 samples positive for oxychlordane in the Southeast, Midwest, and Southwest. The lowest number of samples positive for oxychlordane, 107, was from the Northwest. The range of all samples positive for oxychlordane on a fat adjusted basis was from 13.16 to 5,700.00 ppb. The highest level was found in a sample collected from the Southwest. The mean level of oxychlordane on a fat adjusted basis was highest in the Southeast, followed by the Southwest, Northeast, Midwest, and Northwest. These mean values ranged from a low of 75.40 ppb in the Northwest to a high of 116.25 ppb in the Southeast.

Figure 2. Range and Mean Values of Dieldrin by Geographic Regions for All Positive Human Milk Samples on an Adjusted Fat Basis. Human Milk Study, 1975.

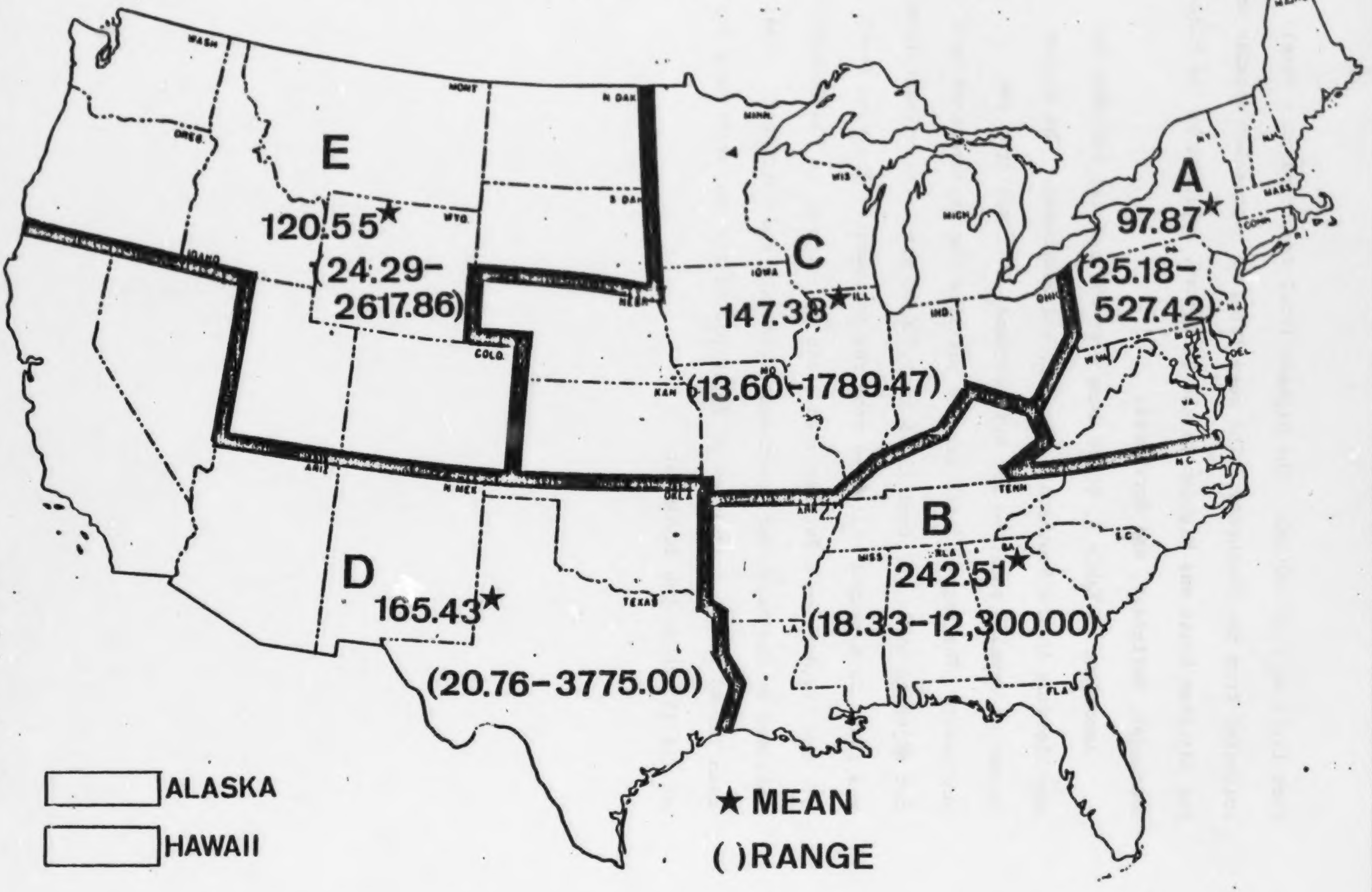

E
120.55★
(24.29–
2617.86)
C
147.38★
(13.60–1789.47)
A
97.87★
(25.18–
527.42)
D
165.43★
(20.76–3775.00)
B
242.51★
(18.33–12,300.00)
ALASKA
HAWAII
★ MEAN
( ) RANGE

Figure 3. Range and Mean Values of Heptachlor Epoxide by Geographic Regions for All Positive Human Milk Samples on an Adjusted Fat Basis. Human Milk Study, 1975.

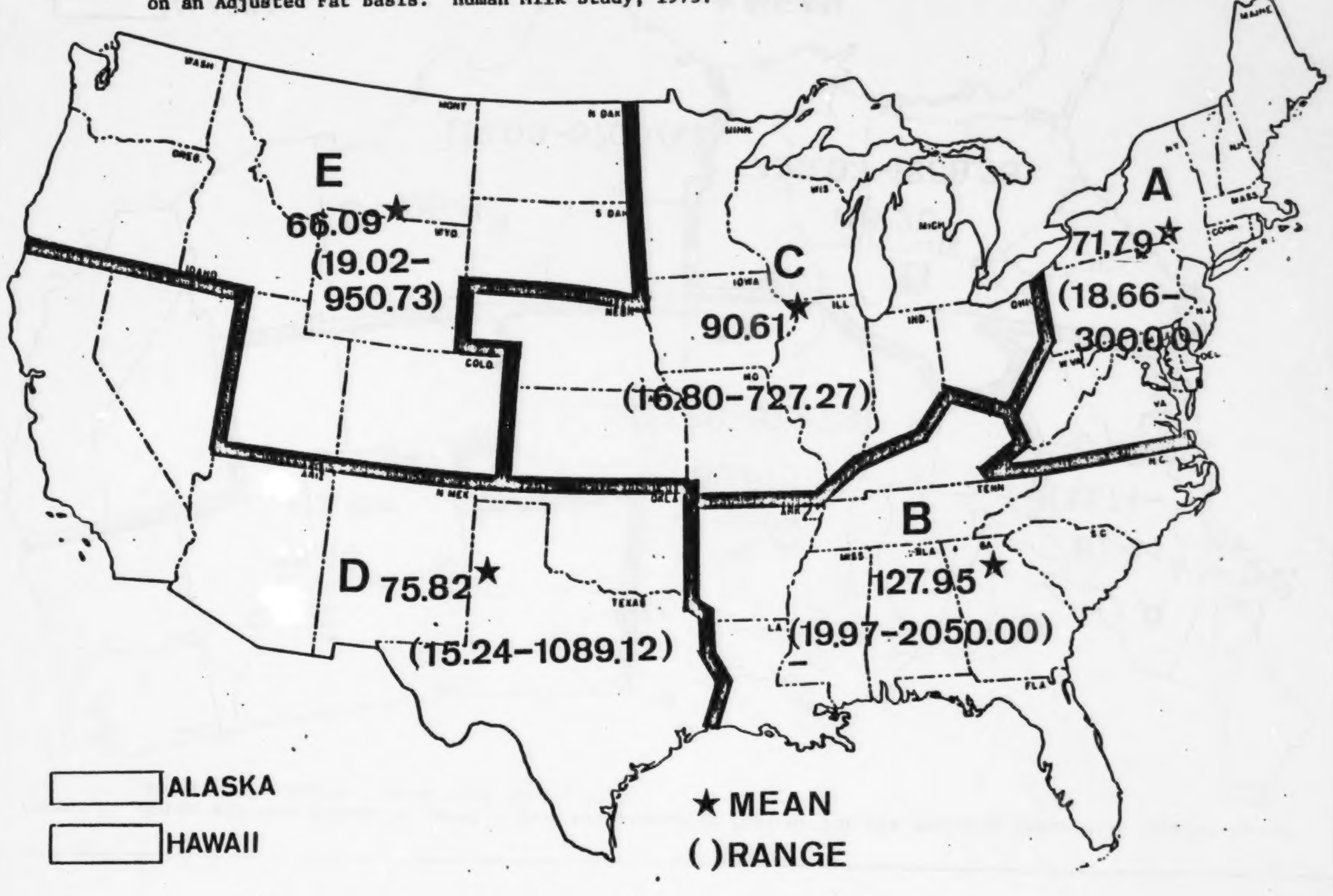

A
71.79
(18.66–300.00)
B
127.95
(19.97–2050.00)
C
90.61
(16.80–727.27)
D
75.82
(15.24–1089.12)
E
66.09
(19.02–950.73)
ALASKA
HAWAII
★ MEAN
( ) RANGE
WASH
OREG.
IDAHO
MONT
WYO
N DAK
S DAK
NEBR
COLO.
MINN.
IOWA
WIS
MICH
ILL
IND.
OHIO
MO
N MEX
OKLA
TEXAS
ARK
LA
MISS
ALA
GA
TENN
N.C.
S.C.
FLA
VA
W VA
N.Y.
N.J.
DEL
MASS
CONN
R.I.
MAINE

Figure 4. Range and Mean Values of Oxychlordane by Geographic Regions for All Positive Human Milk Samples on an Adjusted Fat Basis. Human Milk Study, 1975.

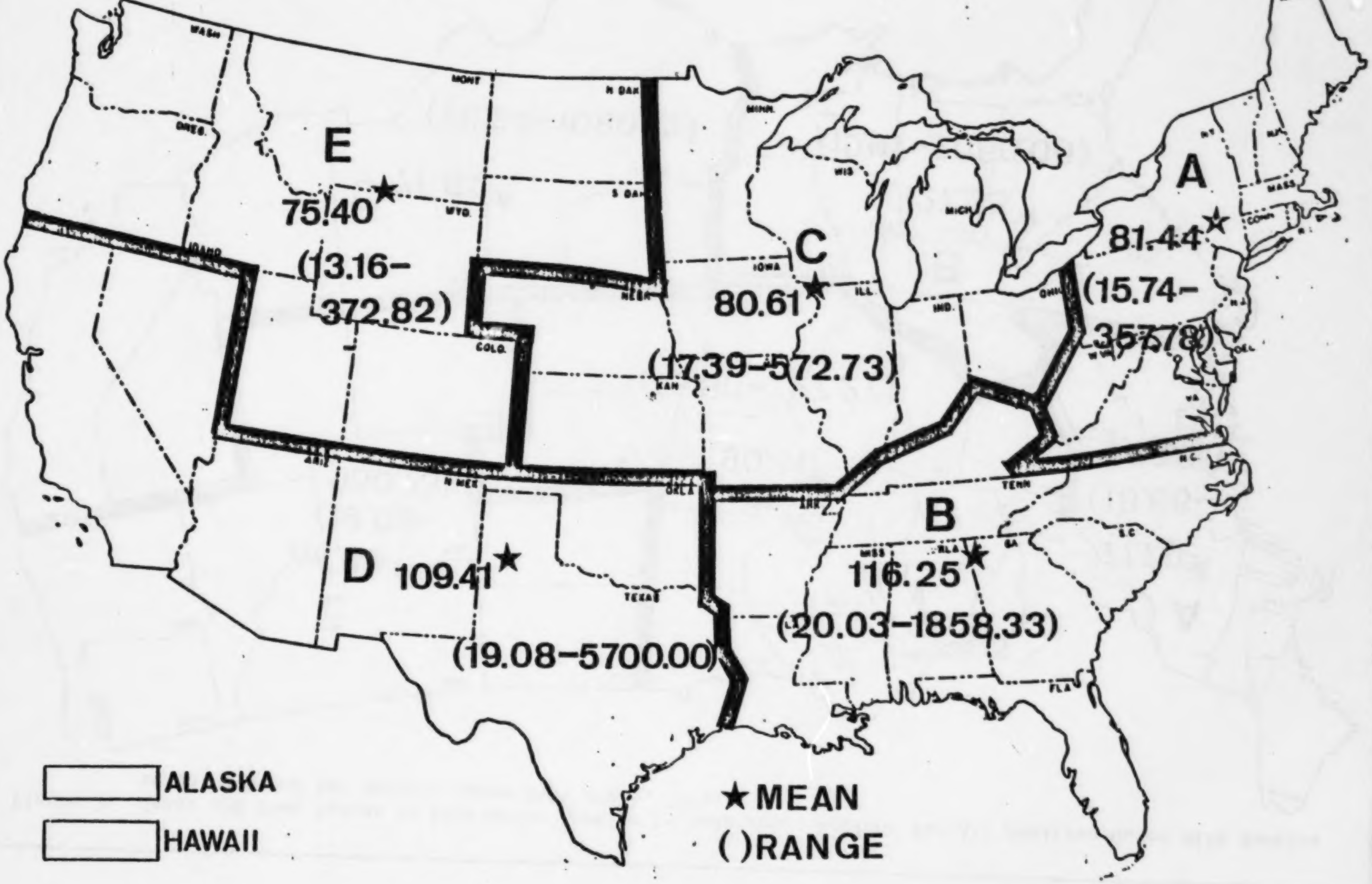

A
81.44
(15.74-
357.78)
B
116.25
(20.03-1858.33)
C
80.61
(17.39-572.73)
D
109.41
(19.08-5700.00)
E
75.40
(13.16-
372.82)
ALASKA
HAWAII
★ MEAN
( ) RANGE
WASH
OREG
IDAHO
MONT
WYO
N DAK
S DAK
NEB
COLO
KAN
ARIZ
N MEX
OKLA
TEXAS
MINN
IOWA
WIS
ILL
MICH
IND
OHIO
ARK
TENN
MISS
ALA
GA
S C
N C
VA
W VA
FLA
N Y
PA
N J
DEL
CONN
MASS
R I
N H
MAINE

Table 4

DIELDRIN LEVELS IN PPB IN MILK OF NURSING MOTHERS ON A FAT ADJUSTED BASIS

Five United States Regions

Human Milk Study 1975

Fat Adjusted Samples

Geographic Region	Number Samples Positive	Range	Mean
Northeast	N= 149	(25.18) - (527.42)	97.87
Southeast	N= 256	(18.33) - (12300.00)	242.31
Midwest	N= 298	(13.60) - (1789.47)	147.38
Southwest	N= 332	(20.76) - (3775.00)	165.43
Northwest	N= 125	(24.29) - (2617.86)	120.55

N, range, and mean include only samples with levels above the sensitivity limit, 1 ppb.

Table 5

HEPTACHLOR EPOXIDE LEVELS IN PPB IN MILK OF NURSING MOTHERS ON A FAT ADJUSTED BASIS

Five United States Regions

Human Milk Study 1975

Fat Adjusted Samples

Geographic Region	Number Samples Positive	Range	Mean
Northeast	N= 144	(18.66) - (300.00)	71.79
Southeast	N= 221	(19.97) - (2050.00)	127.95
Midwest	N= 272	(16.8) - (727.27)	90.61
Southwest	N= 178	(15.24) - (1089.12)	75.82
Northwest	N= 91	(19.02) - (950.73)	66.09

N, range, and mean include only samples with levels above the sensitivity level, 1 ppb.

Table 6

OXYCHLORDANE LEVELS IN PPB IN MILK OF NURSING MOTHERS ON A FAT ADJUSTED BASIS

Five United States Regions

Human Milk Study 1975

Fat Adjusted Samples

Geographic Region	Number Samples Positive	Range	Mean
Northeast	N= 165	(15.74) - (357.78)	81.44
Southeast	N= 239	(20.03) - (1858.33)	116.25
Midwest	N= 272	(17.39) - (572.73)	80.61
Southwest	N= 278	(19.08) - (5700.00)	109.41
Northwest	N= 107	(13.16) - (372.82)	75.40

N, range, and mean include only samples with levels above the sensitivity limit, 1 ppb.

Tables 7, 8, and 9 give breakdowns of the fat adjusted levels of dieldrin, heptachlor epoxide, and oxychlordane by region. Within each region the levels are broken into eight intervals: below detection limits, 1-50 ppb, 51-75 ppb, 76-100 ppb, 101-150 ppb, 151-250 ppb, 251-500 ppb, and greater than 500 ppb. Within each of these intervals, the number of samples falling into the interval and their mean and standard deviation are given. For example, according to Table 7, on a fat adjusted basis, there were 38 milk samples in the Northeast which had dieldrin levels between 101-150 ppb. The mean value for these samples was 124.4 ppb with a standard deviation of about 14.9 ppb. The overall mean levels are also included in these tables for all samples that had whole milk levels above the sensitivity level of 1 ppb. Hence, in the Northeast there were 233 samples and of these, 149 samples had whole milk levels of dieldrin above the sensitivity level. These 149 samples had a mean level of 97.87 ppb with a standard deviation of 59.07 ppb.

Table 7

FAT ADJUSTED DIELDRIN LEVELS IN HUMAN MILK BY U.S. REGION

Human Milk Study 1975

		REGION					
LEVEL		Northeast	Southeast	Midwest	Southwest	Northwest	Total
0	n	8	8	27	15	3	61
Trace	n	76	24	53	41	21	215
1-50 ppb	n	21	13	19	38	22	113
	x̄	40.633	38.921	40.062	39.655	42.587	40.392
	S.D.	9.163	11.233	9.513	8.368	7.449	8.832
51-75 ppb	n	40	59	40	61	40	240
	x̄	64.903	63.400	64.166	62.935	63.575	63.689
	S.D.	6.668	7.120	7.419	7.120	6.769	7.011
76-100 ppb	n	34	59	69	66	31	259
	x̄	87.250	88.476	88.307	87.414	87.664	87.902
	S.D.	8.251	7.849	7.418	7.347	8.212	7.665
101-150 ppb	n	38	48	92	71	16	265
	x̄	124.358	125.709	122.527	124.263	121.899	123.793
	S.D.	14.929	14.914	14.938	15.482	13.340	14.932
151-250 ppb	n	14	37	50	49	9	159
	x̄	184.045	197.471	186.599	189.558	188.729	189.937
	S.D.	32.631	28.807	29.077	28.294	33.576	29.312
251-500 ppb	n	1	27	19	30	4	81
	x̄	337.500	347.747	313.221	316.394	333.611	327.212
	S.D.	0	83.394	46.193	58.953	65.466	66.310
>500 ppb	n	1	13	9	17	3	43
	x̄	527.419	2294.993	882.698	953.234	1295.892	1358.122
	S.D.	0	3147.065	496.948	789.673	1144.990	1892.066
Totals	n	233	288	378	388	149	1436
	*x̄	97.873	242.309	147.379	165.431	120.549	164.246
	*S.D.	59.07	837.135	167.598	264.572	242.905	436.264

* - x̄ and S.D. are computed only for levels above the sensitivity level, 1 ppb.

Table 8

FAT ADJUSTED HEPTACHLOR EPOXIDE LEVELS IN HUMAN MILK BY U.S. REGION

Human Milk Study 1975

LEVEL		REGION					
		North-east	South-east	Midwest	South-west	North-west	Total
0	n	3	9	18	48	17	95
Trace	n	86	58	88	162	41	435
1- 50 ppb	n	48	61	58	81	55	303
	$\bar{x}$	38.442	38.059	40.027	35.747	35.879	37.483
	S.D.	8.053	8.231	7.972	8.718	10.014	8.737
51- 75 ppb	n	47	59	79	49	19	253
	$\bar{x}$	61.564	61.183	62.280	60.571	60.912	61.457
	S.D.	7.657	6.910	7.421	7.335	7.317	7.295
76-100 ppb	n	31	32	62	20	8	153
	$\bar{x}$	88.726	86.781	87.868	86.671	86.825	87.604
	S.D.	8.038	7.129	7.835	7.402	10.097	7.738
101-150 ppb	n	13	23	45	15	3	99
	$\bar{x}$	123.558	127.518	121.443	127.339	128.382	124.236
	S.D.	11.759	13.980	15.415	13.318	16.634	14.375
151-250 ppb	n	2	23	25	9	5	64
	$\bar{x}$	196.323	197.236	198.322	192.523	170.558	194.885
	S.D.	16.984	24.184	29.965	26.032	35.133	27.746
251-500 ppb	n	3	20	1	2	0	26
	$\bar{x}$	283.333	367.771	266.871	309.510	0	349.666
	S.D.	23.662	65.264	0	46.548	0	67.542
>500	n	0	3	2	2	1	8
	$\bar{x}$	0	1581.613	633.636	818.524	950.728	1074.986
	S.D.	0	747.260	132.422	382.666	0	607.964
Totals	n	233	288	378	388	149	1436
	*$\bar{x}$	71.793	127.955	90.613	75.819	66.087	91.360
	*S.D.	44.095	209.258	67.291	97.565	100.859	125.225

* - $\bar{x}$ and S.D. are computed only for levels above the sensitivity level, 1 ppb.

Table 9

FAT ADJUSTED OXYCHLORDANE LEVELS IN HUMAN MILK BY U.S. REGIONS

Human Milk Study 1975

		REGION					
LEVEL		North-east	South-east	Midwest	South-west	North-west	Total
0	n	3	8	17	17	7	52
Trace	n	65	41	89	93	35	323
1-50 ppb	n	38	32	57	69	30	226
	$\bar{x}$	38.776	40.218	41.700	37.003	38.263	39.108
	S.D.	7.959	9.058	6.877	9.061	9.265	8.528
51-75 ppb	n	51	61	100	89	45	346
	$\bar{x}$	63.163	62.484	62.700	61.347	62.529	62.360
	S.D.	7.023	6.258	7.070	6.272	6.673	6.664
76-100 ppb	n	44	58	69	52	16	239
	$\bar{x}$	87.087	87.716	86.216	87.505	87.822	87.128
	S.D.	7.758	7.786	7.321	7.435	7.880	7.540
101-150 ppb	n	20	51	31	34	10	146
	$\bar{x}$	122.840	121.364	116.171	119.244	121.892	120.006
	S.D.	14.344	12.738	12.695	13.915	12.551	13.243
151-250 ppb	n	11	27	10	26	4	78
	$\bar{x}$	190.518	187.653	195.555	182.407	207.116	188.320
	S.D.	38.309	29.893	34.234	26.111	13.938	29.934
251-500 ppb	n	1	6	4	4	2	17
	$\bar{x}$	357.778	330.040	299.508	370.777	326.919	333.706
	S.D.	0	18.298	48.952	85.736	64.908	53.651
>500 ppb	n	0	4	1	4	0	9
	$\bar{x}$	0	1090.409	572.727	1893.388	0	1389.768
	S.D.	0	535.363	0	2539.156	0	1667.421
Totals	n	233	288	378	388	149	1436
	*$\bar{x}$	81.436	116.252	80.601	109.413	75.402	95.786
	*S.D.	46.533	152.279	52.94	345.873	51.435	195.09

* - $\bar{x}$ and S.D. are computed only for levels above the sensitivity level, 1 ppb.

Tables 10, 11, and 12 give the percentage distribution of fat adjusted levels by geographic region for dieldrin, heptachlor epoxide, and oxychlordane. For example, 16.3 percent of the 233 milk samples taken in the Northeast have fat adjusted levels of dieldrin between 101-150 ppb.

Table 10. PERCENT DISTRIBUTION OF FAT ADJUSTED DIELDRIN LEVELS BY GEOGRAPHICAL AREA.
N = 1436

Human Milk Study 1975

Levels	A (NE)		B (SE)		C (Midwest)		D (SW)		E (NW)	
in PPB	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
0	3.4	3.4	2.8	2.8	7.1	7.1	3.9	3.9	2.0	2.0
Trace	32.6	36.0	8.3	11.1	14.0	21.1	10.6	14.5	14.1	16.1
1- 50	9.0	45.0	4.5	15.6	5.0	26.1	9.8	24.3	14.8	30.9
51- 75	17.2	62.2	20.5	36.1	10.6	36.7	15.7	40.0	26.8	57.7
76-100	14.6	76.8	20.5	56.6	18.3	55.0	17.0	57.0	20.8	78.5
101-150	16.3	93.1	16.7	73.3	24.3	79.3	18.3	75.3	10.7	89.2
151-250	6.0	99.1	12.8	86.1	13.2	92.5	12.6	87.9	6.0	95.2
251-500	.4	99.5	9.4	95.5	5.0	97.5	7.7	95.6	2.7	97.9
>500	.5	100.0	4.5	100.0	2.5	100.0	4.4	100.0	2.1	100.0

Table 11. PERCENT DISTRIBUTION OF FAT ADJUSTED HEPTACHLOR EPOXIDE LEVELS BY GEOGRAPHICAL AREA. N = 1436

Human Milk Study 1975

Levels	A (NE)		B (SE)		C (Midwest)		D (SW)		E (NW)	
in PPB	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
0	1.3	1.3	3.1	3.1	4.8	4.8	12.4	12.4	11.4	11.4
Trace	36.9	38.2	20.1	23.2	23.3	28.1	41.8	54.2	27.5	38.9
1- 50	20.6	58.8	21.2	44.4	15.3	43.4	20.9	75.1	36.9	75.8
51- 75	20.2	79.0	20.5	64.9	20.9	64.3	12.6	87.7	12.8	88.6
76-100	13.3	92.3	11.1	76.0	16.4	80.7	5.2	92.9	5.4	94.0
101-150	5.6	97.9	8.0	84.0	11.9	92.6	3.9	96.8	2.0	96.0
151-250	.9	98.8	8.0	92.0	6.6	99.2	2.3	99.1	3.4	99.4
251-500	1.2	100.0	6.9	98.9	0.3	99.5	0.5	99.6	0	99.4
>500	0	100.0	1.1	100.0	0.5	100.0	0.4	100.0	0.6	100.0

Table 12. PERCENT DISTRIBUTION OF FAT ADJUSTED OXYCHLORDANE LEVELS BY GEOGRAPHICAL AREA. N = 1436

Human Milk Study 1975.

Levels in PPB	A (NE)		B (SE)		C (Midwest)		D (SW)		E (NW)	
	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
0	1.3	1.3	2.8	2.8	4.5	4.5	4.4	4.4	4.7	4.7
Trace	27.9	29.2	14.2	17.0	23.5	28.0	24.0	28.4	23.5	28.2
1- 50	16.3	45.5	11.1	28.1	15.1	43.1	17.8	46.2	20.1	48.3
51- 75	21.9	67.4	21.2	49.3	26.5	69.6	22.9	69.1	30.2	78.5
76-100	18.9	86.3	20.1	69.4	18.3	87.9	13.4	82.5	10.7	89.2
101-150	8.6	94.9	17.7	87.1	8.2	96.1	8.8	91.3	6.7	95.9
151-250	4.7	99.6	9.4	96.5	2.6	98.7	6.7	98.0	2.7	98.6
250-500	.4	100.0	2.1	98.6	1.1	99.8	1.0	99.0	1.4	100.0
>500	0	100.0	1.4	100.0	0.2	100.0	1.0	100.0	0	100.0

In Tables 13, 14, and 15 the distribution of fat adjusted levels of dieldrin, heptachlor epoxide, and oxychlordane, respectively, for urban and rural areas are given. According to Table 13, of the milk samples taken in the urban area, 20.4 percent have fat adjusted levels of dieldrin between 76-100 ppb and 66.1 percent have levels less than 101 ppb.

The distributions of fat adjusted levels of the three chemicals for each race are given in Tables 16, 17, and 18. It is seen, for example in Table 16, that 17.6 percent of the milk samples from American Indians have fat adjusted levels of dieldrin between 76 and 100 ppb, while 58.8 percent of the milk samples from American Indians have adjusted levels of dieldrin less than 101 ppb.

Table 13. PERCENT DISTRIBUTION OF FAT ADJUSTED DIELDRIN LEVELS BY URBAN-RURAL AREAS. N = 1400*

Human Milk Study 1975

Levels	Urban		Rural	
in PPB	%	Cum %	%	Cum %
0	3.4	3.4	4.3	4.3
Trace	14.5	17.9	15.2	19.5
1- 50	11.2	29.1	7.5	27.0
51- 75	16.5	45.6	16.8	43.8
76-100	20.4	66.0	17.6	61.4
101-150	15.5	81.5	18.8	80.2
151-250	11.2	92.7	11.1	91.3
251-500	4.4	97.1	5.8	97.1
>500	2.9	100.0	2.9	100.0

*Urban-rural classification not coded for 36 participants.

Table 14. PERCENT DISTRIBUTION OF FAT ADJUSTED HEPTACHLOR EPOXIDE LEVELS BY URBAN-RURAL AREAS. N = 1400*

Human Milk Study 1975

Levels in PPB	Urban %	Urban Cum %	Rural %	Rural Cum %
0	7.3	7.3	6.4	6.4
Trace	29.1	36.4	30.3	36.7
1- 50	23.8	60.2	20.7	57.4
51- 75	16.0	76.2	18.0	75.4
76-100	10.2	86.4	10.7	86.1
101-150	6.8	93.2	7.0	93.1
151-250	4.8	98.0	4.5	97.6
251-500	1.5	99.5	1.9	99.5
>500	.5	100.0	.5	100.0

*Urban-rural classification not coded for 36 participants.

Table 15. PERCENT DISTRIBUTION OF FAT ADJUSTED OXYCHLORDANE LEVELS BY URBAN-RURAL AREAS. N = 1400*

Human Milk Study 1975

Levels in PPB	Urban %	Urban Cum %	Rural %	Rural Cum %
0	3.4	3.4	3.7	3.7
Trace	19.4	22.8	23.1	26.8
1- 50	18.4	41.2	15.1	41.9
51- 75	25.7	66.9	24.0	65.9
76-100	17.5	84.4	16.4	82.3
101-150	11.2	95.6	10.0	92.3
151-250	3.4	99.0	5.7	98.0
251-500	1.0	100.0	1.3	99.3
>500	0		.7	100.0

*Urban-rural classification not coded for 36 participants.

Table 16. PERCENT DISTRIBUTION OF FAT ADJUSTED LEVELS DIELDRIN LEVELS BY RACE. N = 1436

Human Milk Study 1975

Levels	White N=1210		Black N=37		Mexican Am. N=42		Am. Indian N=17		Other* N=130	
in PPB	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
0	4.7	4.7	2.7	2.7	0	0	5.9	5.9	1.5	1.5
Trace	15.5	20.2	5.4	8.1	7.1	7.1	5.9	11.8	16.2	17.7
1- 50	7.7	27.9	13.5	21.6	0	7.1	11.8	23.6	10.0	27.7
51- 75	16.3	44.2	32.4	54.0	19.0	26.1	17.6	41.2	15.4	43.1
76-100	18.0	62.2	13.5	67.5	7.1	33.2	17.6	58.8	23.1	66.2
101-150	18.7	80.9	16.2	83.7	9.5	42.7	23.5	82.3	19.2	85.4
151-250	10.9	91.8	13.5	97.2	16.7	59.4	11.8	94.1	10.0	95.4
251-500	5.5	97.3	2.8	100	21.5	80.9	0	94.1	3.8	99.2
>500	2.7	100	0	100	19.1	100	5.9	100	0.8	100

* Other includes unknown as well as other rades.

Table 17. PERCENT DISTRIBUTION OF FAT ADJUSTED HEPTACHLOR EPOXIDE LEVELS BY RACE. N = 1436

Human Milk Study 1975

Levels	White N=1210		Black N=37		Mexican Am. N=42		Am. Indian N=17		Other* N=130	
in PPB	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
0	6.4	6.4	8.1	8.1	14.3	14.3	17.6	17.6	4.6	4.6
Trace	29.6	36.0	29.7	37.8	45.2	59.5	47.1	64.7	30.0	34.6
1- 50	20.9	56.9	35.1	72.9	14.3	73.8	17.6	82.3	21.5	55.1
51- 75	17.8	74.7	13.5	86.4	19.0	92.8	11.8	94.1	17.7	72.8
76-100	10.7	85.4	10.8	97.2	2.4	95.2	5.9	100	13.8	86.6
101-150	7.1	92.5	2.8	100	2.4	97.6	0	100	8.5	95.1
151-250	4.9	97.4	0	100	2.4	100	0	100	3.1	98.2
251-500	2.1	99.5	0	100	0	100	0	100	0.8	100
>500	0.5	100	0	100	0	100	0	100	0	100

* Other includes unknown as well as other races.

Table 18. PERCENT DISTRIBUTION OF FAT ADJUSTED OXYCHLORDANE LEVELS BY RACE. N = 1436

Human Milk Study 1975

Levels	White N=1210		Black N=37		Mexican Am. N=42		Am. Indian N=17		Other* N=130	
in PPB	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
0	3.7	3.7	0	0	2.4	2.4	11.8	11.8	3.1	3.1
Trace	21.2	24.9	8.1	8.1	42.9	45.3	17.6	29.4	32.3	35.4
1- 50	16.3	41.2	2.7	10.8	2.4	47.7	11.8	41.2	19.2	54.6
51- 75	25.0	66.2	32.4	43.2	14.3	62.0	11.8	53	18.5	73.1
76-100	16.2	82.4	29.7	72.9	9.5	71.5	41.2	94.2	16.2	89.3
101-150	10.5	92.9	16.2	89.1	9.5	81.0	5.8	100	6.2	95.5
151-250	5.5	98.4	8.1	97.2	14.3	95.3	0	100	2.3	97.8
251-500	1.1	99.5	2.8	100	2.4	97.7	0	100	1.5	99.3
>500	.5	100	0	100	2.3	100	0	100	0.7	100

* Other includes unknown as well as other races.

Tables 19, 20, and 21 give the distribution of the number of nursing mothers, each classified by the number of siblings previously breastfed, and by the fat adjusted level of dieldrin, heptachlor epoxide, and oxychlordane respectively, in their milk. To test for possible association between the level of pesticide and the number of children previously nursed, a chi-square test of independence was computed for each of the tables by combining sibling classes 5 through 10. The chi-square statistics (each with 40 degrees of freedom) were: 67.56 for dieldrin ($P = .004$), 50.29 for heptachlor epoxide ($P = .1276$), and 65.48 for oxychlordane ($P = .0067$). Thus, there is a significant relationship between the number of children previously nursed and the fat adjusted level of dieldrin and oxychlordane pesticides in milk.

Table 22 consists of the number and proportion of mothers, classified according to the number of children previously nursed, with levels of dieldrin, heptachlor epoxide, or oxychlordane greater than 100 ppb on a fat adjusted basis. For example, in the group of 664 mothers who had never nursed another child, 291 (43.8%) have fat adjusted levels of dieldrin greater than 100 ppb and 145 (21.8%) have fat adjusted levels of oxychlordane greater than 100 ppb. Examination of Table 22 suggests that a pattern exists between the proportion of mothers with high levels of pesticides and the number of children previously nursed. It appears that the proportion of mothers with high levels of pesticides decreases as the number of previously nursed children increases. This pattern was tested statistically as follows.

The data in Table 22 can be viewed as a 6x2 contingency table in which the row classification is the number of children previously nursed and the column classification is the combined level of the pesticide. The row classifications can be regarded as a covariate X of the proportion of mothers with

Table 19. DIELDRIN LEVELS IN MILK OF NURSING MOTHERS BY NUMBER OF SIBLINGS PREVIOUSLY BREASTFED. N = 1436

Fat Adjusted Levels

Human Milk Study 1975

Dieldrin Levels in PPB		Number of Siblings Previously Breastfed										
		0	1	2	3	4	5	6	7	8	10	Row Total
0	N=	25	19	11	3	1	0	0	2	0	0	61
Trace	N=	90	72	33	15	4	1	0	0	0	0	215
1- 50	X=	39.812	42.826	40.040	32.664	41.513	26.000	35.054	46.512	0	0	40.392
	N=	35	37	25	7	6	1	1	1	0	0	113
	SD=	10.188	7.981	6.853	11.458	3.671	0	0	0	0	0	8.832
51- 75	X=	63.212	64.166	64.540	61.098	71.823	63.053	69.944	53.488	0	0	63.689
	N=	98	86	33	16	3	2	1	1	0	0	240
	SD=	7.154	6.971	6.427	7.185	3.430	4.317	0	0	0	0	7.011
76-100	X=	87.841	86.929	90.549	90.175	88.954	83.470	84.906	76.923	89.902	0	87.902
	N=	125	83	29	12	5	2	1	1	1	0	259
	SD=	7.457	7.986	7.673	7.692	7.264	.193	0	0	0	0	7.665
101-150	X=	124.016	124.185	120.295	127.054	122.616	0	0	0	147.706	103.04	123.793
	N=	144	84	25	7	3	0	0	0	1	1	265
	SD=	14.888	15.394	13.431	15.533	12.556	0	0	0	0	0	14.932
151-250	X	191.595	183.48	195.805	190.166	0	0	150.376	0	0	233.179	189.937
	N=	93	41	18	5	0	0	1	0	0	1	159
	SD=	28.341	30.103	32.416	20.768	0	0	0	0	0	0	29.312
251-500	X=	329.737	329.178	314.444	325.382	0	0	0	0	0	0	327.212
	N=	39	26	11	5	0	0	0	0	0	0	81
	SD=	71.239	63.415	64.161	61.336	0	0	0	0	0	0	66.310
>500	X=	1279.681	920.463	1189.186	12300.000	906.616	0	0	581.206	0	0	1358.123
	N=	15	15	9	1	2	0	0	1	0	0	43
	SD=	1088.405	528.127	838.47	0	533.165	0	0	0	0	0	1892.067
Column Total	*X=	157.195	146.876	176.334	340.669	162.652	63.809	85.07	189.532	118.804	168.109	164.246
	N=	664	463	194	71	24	6	4	6	2	2	1436
	*SD=	267.378	203.069	330.851	1676.463	292.177	23.177	48.28	261.439	40.878	92.022	436.246

* - $\bar{X}$ and SD are computed only for levels above the sensitivity level, 1 ppb.

Table 20. HEPTACHLOR EPOXIDE LEVELS IN MILK OF NURSING MOTHERS BY NUMBER OF SIBLINGS PREVIOUSLY BREASTFED. N = 1436
Fat Adjusted Levels

Human Milk Study 1975

Heptachlor Epoxide Levels in PPB		Number of Siblings Previously Breastfed										
		0	1	2	3	4	5	6	7	8	10	Row Total
0	N=	43	29	12	7	2	1	0	1	0	0	95
Trace	N=	173	157	72	24	7	0	1	1	0	0	435
1- 50	X=	37.969	38.015	36.530	32.217	39.566	25.574	43.396	46.512	0	26.720	37.483
	N=	138	102	37	15	6	2	1	1	0	1	303
	SD=	8.319	8.795	8.420	9.722	12.428	7.883	0	0	0	0	8.738
51- 75	X=	61.213	61.929	62.994	62.244	60.594	52.267	50.853	56.768	0	50.580	61.458
	N=	115	75	32	17	6	2	2	3	0	1	253
	SD=	7.309	6.784	8.577	5.267	8.161	2.527	1.075	8.887	0	0	7.295
76-100	X=	88.004	85.314	90.463	88.611	83.333	83.333	0	0	94.951	0	87.604
	N=	89	40	16	4	1	1	0	0	2	0	153
	SD=	7.677	7.349	6.995	13.159	0	0	0	0	7.140	0	7.738
101-150	X=	124.686	123.614	125.678	114.52	0	0	0	0	0	0	124.236
	N=	54	27	15	3	0	0	0	0	0	0	99
	SD=	15.325	13.251	14.397	0.775	0	0	0	0	0	0	14.375
151-250	X=	195.609	191.160	201.037	216.667	199.011	0	0	0	0	0	194.885
	N=	31	24	6	1	2	0	0	0	0	0	64
	SD=	27.637	28.518	27.703	0	44.254	0	0	0	0	0	27.746
251-500	X=	364.235	302.848	360.741	0	0	0	0	0	0	0	349.666
	N=	17	6	3	0	0	0	0	0	0	0	26
	SD=	73.145	32.105	55.517	0	0	0	0	0	0	0	67.543
>500	X=	871.737	1045.979	1975.000	0	0	0	0	0	0	0	1074.986
	N=	4	3	1	0	0	0	0	0	0	0	8
	SD=	180.216	869.516	0	0	0	0	0	0	0	0	607.694
Column Total	*X=	95.061	89.586	99.667	61.402	72.154	47.803	48.367	54.204	94.951	38.65	91.360
	N=	664	463	194	71	24	6	4	6	2	2	1436
	*SD=	103.955	136.984	191.649	36.023	55.128	24.285	4.372	8.886	7.140	16.872	125.225

* - $\bar{X}$ and SD are computed only for levels above the sensitivity level, 1 ppb.

Table 21. OXYCHLORDANE LEVELS IN MILK OF NURSING MOTHERS BY NUMBER OF SIBLINGS PREVIOUSLY BREASTFED. N = 1436 Fat Adjusted Levels

Human Milk Study 1975

Oxychlordane Levels in PPB		Number of Siblings Previously Breastfed										
		0	1	2	3	4	5	6	7	8	10	Total
	N=	18	15	12	3	2	0	0	2	0	0	52
Trace	N=	129	107	50	26	7	1	1	2	0	0	323
1- 50	X̄=	40.201	38.563	38.329	37.551	42.950	34.679	33.118	0	0	0	39.108
	N=	90	76	36	16	4	3	1	0	0	0	226
	SD=	7.670	9.265	8.396	9.647	8.900	11.674	0	0	0	0	8.528
51- 75	X̄=	62.774	62.063	61.683	60.765	63.416	57.027	67.925	0	0	69.803	62.360
	N=	171	111	39	16	4	2	1	0	0	2	346
	SD=	6.763	6.697	6.821	5.171	6.146	4.204	0	0	0	3.560	6.664
76-100	X̄=	87.037	86.987	89.377	86.307	79.255	0	0	76.923	87.772	0	87.128
	N=	111	82	33	5	5	0	0	1	2	0	239
	SD=	7.179	7.989	7.577	5.609	2.468	0	0	0	10.806	0	7.540
101-150	X̄=	120.207	119.058	123.964	117.461	0	0	110.019	0	0	0	120.006
	N=	84	44	12	5	0	0	1	0	0	0	146
	SD=	13.219	12.539	14.128	11.061	0	0	0	0	0	0	13.243
151-250	X̄=	182.084	202.091	188.922	0	167.241	0	0	0	0	0	188.320
	N=	48	23	6	0	1	0	0	0	0	0	78
	SD=	28.608	27.976	35.839	0	0	0	0	0	0	0	29.934
251-500	X̄=	342.904	309.391	318.174	0	309.849	0	0	461.348	0	0	333.706
	N=	7	5	3	0	1	0	0	1	0	0	17
	SD=	52.768	37.550	35.882	0	0	0	0	0	0	0	53.651
>500	X̄=	1550.060	0	1069.186	0	0	0	0	0	0	0	1389.768
	N=	6	0	3	0	0	0	0	0	0	0	9
	SD=	2061.531	0	685.791	0	0	0	0	0	0	0	1667.421
Column Total	* X̄=	105.515	83.244	102.410	61.712	86.589	43.618	7 .354	269.135	87.772	69.803	95.786
	N=	664	463	194	71	24	6	4	6	2	2	1436
	*SD=	239.986	51.043	178.418	27.199	69.055	14.913	38.500	271.829	10.806	3.560	195.090

* - X̄ and SD are computed only for levels above the sensitivity level, 1 ppb.

Table 22. Number and Proportion of Nursing Mothers with Fat Adjusted Levels of Dieldrin, Heptachlor Epoxide, or Oxychlordane Greater Than 100 ppb Classified by the Number of Children Previously Breastfed.

Human Milk Study 1975

Number of Children Previously Breastfed	Total Number of Mothers	Mothers with Fat Adjusted Levels Greater Than 100 ppb					
		Dieldrin		Heptachlor Epoxide		Oxychlordane	
		Number	Proportion	Number	Proportion	Number	Proportion
0	664	291	.438	106	.160	145	.218
1	463	166	.359	60	.130	72	.156
2	194	63	.325	25	.129	24	.124
3	71	18	.254	4	.056	6	.085
4	24	5	.208	2	.083	2	.083
5 or more	20	5	.250	0	0	1	.050
TOTAL	1436=N*	548=T**	.382=$\bar{p}$***	197=T	.137=$\bar{p}$	250=T	.174=$\bar{p}$

* N = Total number of mothers involved in the study.

** T = Total number of mothers with more than 100 ppb of the chemical in their milk.

***$\bar{p}$ = T/N = proportion of mothers with level of the chemical higher than 100 ppb.

high levels. Among the n_i mothers who have previously nursed i children, the proportion of mothers who have high levels of the pesticide were denoted by p_i. The covariate x, the number of children previously nursed, was assigned the values $x_o = 0$, $x_1 = 1$, $x_2 = 2$, $x_3 = 3$, $x_4 = 4$, $x_5 = 7$, in which x_5 corresponds to the class of mothers nursing 5 or more children with 7 being the median number of children nursed by mothers in this class.

The standard test for homogeneity of proportions with respect to the variable X can be written as $\chi^2_T = \dfrac{\Sigma n_i\ (p_i - \bar{p})^2}{\bar{p}\quad \bar{q}}$, which is distributed as a chi-square random variable with m-1 degrees of freedom with m signifying the number of columns. A significant value of this statistic indicates that the proportion of high levels is dependent on the value of the variable X. For example, from Table 23, it is seen that the value of χ^2_T for the proportion of high levels of dieldrin among mothers classified according to the number of children previously nursed was 22.19 with 5 degrees of freedom. This value had a P-value of less than .001. The statistical significance indicated that the probability of a mother having a high level of dieldrin in her milk depended on the number of children that the mother had previously nursed.

When the variable X is ordinal, it is reasonable to examine the possibility that p_i and x_i are linearly related, that is, p_i can be approximately represented as $p_i = a + bx_i$ in which a is the intercept and b is the slope of the line. Using a procedure suggested by Cochran (33), the slope parameter b was estimated by $\hat{b} = \dfrac{\Sigma n_i\ (p_i - \bar{p})\ (x_i - \bar{x})}{\Sigma n_i (x_i - \bar{x})^2}$. The variance of $\hat{b}$ was estimated by $s^2_b = \bar{p}(1-\bar{p})/\Sigma n_i (x_i - \bar{x})^2$. The significance of the slope was tested by computing $\chi^2_r = \hat{b}^2/s^2_b$ and

Table 23. Chi-square Analysis of the Proportion of Nursing Mothers with Fat Adjusted Levels of Dieldrin, Heptachlor Epoxide, or Oxychlordane in Their Milk, Classified by the Number of Children Previously Breastfed, the Number of Children, and Age.

Human Milk Study 1975

				Chi-square Analysis								
				Total			Regression			Deviation From Regression		
Chemical	Covariate X	$\hat{b}$ Estimated Slope	S_b^*	X_T^2	DF**	P***	X_r^2	DF	P	X_d^2	DF	P
Dieldrin	Breastfed	-.045	.0106	22.19	5	<.001	18.18	1	<.001	4.01	4	.404
Heptachlor Epoxide	Breastfed	-.022	.0074	10.86	5	.054	9.8	1	.002	1.68	4	.794
Oxychlordane	Breastfed	-.034	.0081	21.07	5	<.001	17.08	1	<.001	3.99	4	.407
Dieldrin	Siblings	-.032	.0092	15.01	5	.01	11.94	1	<.001	3.07	4	.546
Heptachlor Epoxide	Siblings	-.010	.0066	5.24	5	.387	2.4	1	.121	2.84	4	.584
Oxychlordane	Siblings	-.023	.0071	14.85	5	.011	10.83	1	.001	4.02	4	.403
Dieldrin	Age	-1.04×10^{-3}	.0025	3.57	4	.467	.17	1	.680	3.40	3	.334
Heptachlor Epoxide	Age	$+3.9 \times 10^{-4}$	.0018	3.48	4	.481	.05	1	.823	3.43	3	.330
Oxychlordane	Age	-3.7×10^{-5}	.002	2.52	4	.641	.0003	1	.986	2.52	3	.472

* $S_b = \sqrt{S_b^2}$ in the standard error of $\hat{b}$.

** DF is degrees of freedom.

***P is the P-value of the X^2 statistic.

comparing χ_r^2 with a chi-square distribuion with 1 degree of freedom. A significant value of χ_r^2 indicated that the slope b of the equation $p_i = a + bx_i$ was nonzero. The value of $\hat{b}$ for the proportion of mothers with high levels of dieldrin who were classified according to the number of children previously nursed, was -.045 with variance .000112. In comparison with a chi-square distribution with 1 degree of freedom, the value of 18.18 for χ_r^2 is significant at the .001 level. Hence, the slope of the line describing the relationships between p_i and x_i, or the number of children previously nursed, was significantly different from zero. The goodness of fit of the model $p_i = a + bx_i$, that is, the degree to which the equation describes the data, was tested by computing $\chi_d^2 = \chi_t^2 - \chi_r^2$ and comparing its value with a chi-square distribution with m-2 degrees of freedom. Since χ_d^2 measured the deviation of the observed values of the proportions p_i from $\hat{p}_i$, small χ_d^2 values predicted by the equation $\hat{p}_i = \hat{a} + \hat{b}x_i$ indicated that the data was well described by the model. Conversely, a large value of χ_d^2 indicates that the model is a poor predictor of the observed proportions. Therefore, a significant value of χ_r^2 in combination with a nonsignificant value of χ_d^2 indicates a strong linear relationship between p_i and x_i. In the example involving dieldrin levels of mothers who were classified by the number of children previously nursed, the χ_d^2 was found to be 4.01 with 4 degrees of freedom. Hence, the proportion of mothers with high levels of dieldrin was linearly related to the number of children previously nursed. As the number of children previously nursed increased, the proportion of mothers with high levels of dieldrin tended to decrease.

Examination of Table 23 revealed conclusions similar to the above for heptachlor epoxide and oxychlordane. The proportion of mothers with high levels of heptachlor epoxide and oxychlordane was related linearly to the number of children nursed previously. Therefore, as the number of children nursed previously increased, the proportion of mothers with high levels of heptachlor epoxide and the proportion of mothers with high levels of oxychlordane decreased.

The standard test for homogeneity of proportions which was used to determine the relationship between levels of pesticides in mothers' milk and the number of children previously nursed, applied in the analysis of the pesticide levels on a fat adjusted basis for mothers classified by the number of siblings. In Tables 24, 25, and 26 the distribution of the number of nursing mothers classified by the total number of siblings for fat adjusted milk levels of dieldrin, heptachlor epoxide, and oxychlordane is given. The chi-square statistics (each with 40 degrees of freedom) were: 59.19 for dieldrin (P = 0.26), 47.28 for heptachlor epoxide (P = .20), and 68.29 for oxychlordane (P = .0035). Based on these tests of significance there is some indication that the level of pesticides is associated with the number of siblings. In Table 27, the number and proportions of mothers with levels of dieldrin, heptachlor epoxide, or oxychlordane higher than 100 ppb on a fat adjusted basis is given, each classified according to the number of siblings. Here, the covariate x was the number of siblings with $x_0 = 0$, $x_1 = 1$, $x_2 = 2$, $x_3 = 3$, $x_4 = 4$, $x_5 = 7$ as before, the apparent linear relation between the proportion of mothers with high levels of one (or more) of the three pesticides and the number of siblings was tested. The results of the tests are shown in Table 23. Since the values 11.94 and 10.83 of χ_r^2 for dieldrin and oxychlordane, respectively, were significant at the .001 level and χ_d^2 was nonsignificant in both cases, there was evidence of a linear relationship. This linear relationship did not apply for heptachlor epoxide.

It should be noted that the number of children previously breastfed and the number of siblings was strongly correlated ($r = .85$); therefore, it was not surprising that a linear relationship existed between the number of siblings and the proportions of high pesticide levels.

Tables 28, 29, and 30 indicate the distributions of the number of nursing mothers classified by age and level of pesticide. The chi-square values (each with 32 degrees of freedom) are: 34.91 for dieldrin ($P = .33$), 32.72 for heptachlor epoxide ($P = .43$), and 40.12 for oxychlordane ($P = .15$). In Table 31, the number and proportions of mothers with high pesticide levels for each age group is given. The values of the covariate x, $x_0 = 17$, $x_1 = 22$, $x_3 = 27$, $x_4 = 32$, $x_5 = 40$, are the median ages within each age class. From Tables 23 and 30, it is apparent that a linear relationship between age and the proportion of mothers with high levels did not exist.

Table 24. DIELDRIN LEVELS IN MILK OF NURSING MOTHERS BY TOTAL NUMBER OF SIBLINGS. N = 1436
Fat Adjusted Levels

Human Milk Study 1975

Dieldrin Levels in PPB		Total Number of Siblings											
		0	1	2	3	4	5	6	7	8	9	10	Row Total
0	N=	20	21	13	4	0	1	0	2	0	0	0	61
Trace	N=	70	73	41	22	6	2	0	1	0	0	0	215
1- 50	X=	40.259	43.536	39.387	38.008	37.445	35.238	35.054	46.512	0	0	0	40.392
	N=	28	31	29	12	9	2	1	1	0	0	0	113
	SD=	9.930	7.118	8.785	9.339	9.095	13.065	0	0	0	0	0	8.832
51- 75	X=	63.441	63.758	65.109	60.437	66.489	63.053	69.944	53.488	73.171	0	0	63.689
	N=	82	82	40	22	9	2	1	1	1	0	0	240
	SD=	6.938	7.329	6.535	6.871	5.020	4.317	0	0	0	0	0	7.011
76-100	X=	87.868	87.097	89.048	89.315	90.795	81.020	84.906	76.923	89.902	100.000	0	87.902
	N=	104	78	47	16	6	4	1	1	1	1	0	259
	SD=	7.332	7.715	8.010	8.495	7.908	2.960	0	0	0	0	0	7.665
101-150	X=	123.184	125.917	120.514	126.680	120.680	0	102.790	0	0	147.706	103.040	123.793
	N=	116	91	34	15	5	0	2	0	0	1	1	265
	SD=	14.363	15.515	14.353	15.681	9.419	0	0.768	0	0	0	0	14.932
151-250	X=	189.343	192.919	191.429	185.832	160.236	0	150.376	0	0	0	233.179	189.937
	N=	74	48	21	11	3	0	1	0	0	0	1	159
	SD=	28.033	31.151	31.062	25.426	11.174	0	0	0	0	0	0	29.312
251-500	X=	324.820	331.552	337.142	316.543	302.091	311.765	0	0	0	0	0	327.212
	N=	33	22	15	7	3	1	0	0	0	0	0	81
	SD=	68.486	63.183	77.459	51.003	81.294	0	0	0	0	0	0	66.310
>500	X=	1381.358	966.595	1075.898	6452.632	906.616	632.000	0	581.206	0	0	0	1358.123
	N=	13	12	12	2	2	1	0	1	0	0	0	43
	SD=	1139.313	577.794	750.216	8269.428	533.165	0	0	0	0	0	0	1892.067
Column Total	* X̄=	160.989	145.558	171.804	262.120	142.805	146.443	90.977	189.532	81.537	123.853	168.109	164.246
	N=	540	458	252	111	43	13	6	7	2	2	2	1436
	*SD=	291.055	196.139	301.518	1324.639	218.207	188.289	38.509	261.439	11.831	33.734	92.022	436.264

* - X̄ and SD are computed only for levels above the sensitivity level, 1 ppb.

Table 25. HEPTACHLOR EPOXIDE LEVELS IN MILK OF NURSING MOTHERS BY TOTAL NUMBER OF SIBLINGS. N = 1436

Fat Adjusted Levels

Human Milk Study 1975

Heptachlor Epoxide Levels in PPB		Total Number of Siblings 0	1	2	3	4	5	6	7	8	9	10	Row Total
0	N=	32	29	19	8	2	4	0	1	0	0	0	95
Trace	N=	142	153	83	41	11	2	1	2	0	0	0	435
1- 50	X=	37.492	39.194	36.355	33.478	37.708	25.574	39.047	46.512	0	0	26.720	37.483
	N=	121	90	54	19	12	2	3	1	0	0	1	303
	SD=	8.419	8.633	8.457	9.781	10.395	7.883	3.772	0	0	0	0	8.738
51- 75	X	61.230	61.644	63.385	62.928	56.802	53.346	50.853	56.768	73.171	0	50.580	61.458
	N=	91	79	41	22	10	3	2	3	1	0	1	253
	SD=	7.213	6.935	7.649	7.015	5.413	2.585	1.075	8.888	0	0	0	7.295
76-100	X=	88.013	85.887	90.477	85.975	90.152	83.333	0	0	89.902	100.000	0	87.604
	N=	75	44	17	12	2	1	0	0	1	1	0	153
	SD=	7.951	7.038	6.707	9.414	9.642	0	0	0	0	0	0	7.738
101-150	X=	126.408	121.539	124.712	126.194	110.000	103.086	0	0	0	129.412	0	124.236
	N=	40	30	18	8	1	1	0	0	0	1	0	99
	SD=	15.813	12.395	14.961	12.650	0	0	0	0	0	0	0	14.375
151-250	X=	195.590	196.110	194.183	175.000	192.134	0	0	0	0	0	0	194.885
	N=	23	21	15	1	4	0	0	0	0	0	0	64
	SD=	25.799	32.315	24.459	0	37.062	0	0	0	0	0	0	27.746
251-500	X=	354.323	318.670	417.852	0	300.000	0	0	0	0	0	0	349.666
	N=	12	9	4	0	1	0	0	0	0	0	0	26
	SD=	76.676	42.723	40.020	0	0	0	0	0	0	0	0	67.543
>500	X=	871.737	1045.979	1975.000	0	0	0	0	0	0	0	0	1074.986
	N=	4	3	1	0	0	0	0	0	0	0	0	8
	SD=	180.216	869.516	0	0	0	0	0	0	0	0	0	607.964
Column Total	* $\bar{X}$=	92.804	94.010	99.356	68.335	79.312	56.801	43.769	54.204	81.537	114.706	38.650	91.360
	N=	540	458	252	111	43	13	6	7	2	2	2	1436
	*SD=	107.306	139.288	171.114	33.989	67.543	28.600	7.015	8.885	11.831	20.797	16.872	125.225

* - $\bar{X}$ and SD are computed only for levels above the sensitivity level, 1 ppb.

Table 26. OXYCHLORDANE LEVELS IN MILK OF NURSING MOTHERS BY TOTAL NUMBER OF SIBLINGS. N=1436
Fat Adjusted Levels

Human Milk Study 1975

Oxychlordane Levels in PPB		Total Number of Siblings											Row Total
		0	1	2	3	4	5	6	7	8	9	10	
0	N=	10	19	13	5	1	2	0	2	0	0	0	52
Trace	N=	102	103	64	38	9	3	1	3	0	0	0	323
1- 50	X=	40.184	38.781	38.680	36.879	40.682	34.679	32.430	0	48.781	0	0	39.108
	N=	78	64	52	17	9	3	2	0	1	0	0	226
	SD=	7.500	8.897	9.099	9.277	9.459	11.674	.974	0	0	0	0	8.528
51- 75	X=	62.578	62.240	62.169	62.079	63.008	57.686	60.629	0	0	64.706	69.803	62.360
	N=	138	117	49	25	8	4	2	0	0	1	2	346
	SD=	6.620	6.889	6.549	6.429	7.017	4.974	10.318	0	0	0	3.560	6.664
76-100	X=	87.226	86.517	88.939	89.392	83.128	0	0	76.923	80.130	95.413	0	87.128
	N=	93	83	36	13	11	0	0	1	1	1	0	239
	SD=	7.297	7.814	7.130	7.392	7.598	0	0	0	0	0	0	7.540
101-150	X=	121.305	117.778	120.419	122.786	117.500	0	110.019	0	0	0	0	120.006
	N=	69	47	19	8	2	0	1	0	0	0	0	146
	SD=	13.847	12.643	13.670	10.918	17.678	0	0	0	0	0	0	13.243
151-250	X=	178.135	197.908	203.080	193.477	167.241	177.333	0	0	0	0	0	188.320
	N=	38	20	14	4	1	1	0	0	0	0	0	78
	SD=	26.632	28.390	33.713	32.467	0	0	0	0	0	0	0	29.934
251-500	X=	350.517	309.391	303.196	0	326.003	0	0	461.348	0	0	0	333.706
	N=	6	5	3	0	2	0	0	1	0	0	0	17
	SD=	53.427	37.550	29.714	0	22.846	0	0	0	0	0	0	53.651
>500	X=	1550.059	0	1237.990	731.579	0	0	0	0	0	0	0	1389.768
	N=	6	0	2	1	0	0	0	0	0	0	0	9
	SD=	2041.531	0	877.298	0	0	0	0	0	0	0	0	1667.421
Column Total	* $\bar{X}$=	108.469	83.291	95.864	85.718	86.026	64.014	59.227	269.135	64.455	80.059	69.803	95.786
	N=	540	458	252	111	43	13	6	7	2	2	2	1436
	*SD=	284.744	48.793	150.388	89.467	68.251	47.704	32.122	271.829	22.168	21.713	3.560	195.090

* - $\bar{X}$ and SD are computed only for levels above the sensitivity level, 1 ppb.

Table 27. Number and Proportion of Nursing Mothers with Fat Adjusted Levels of Dieldrin, Heptachlor Epoxide, or Oxychlordane Greater than 100 ppb Classified by the Number of Siblings.

Human Milk Study 1975

Number of Siblings	Total Number of Mothers	Mothers with Fat Adjusted Levels Greater Than 100 ppb					
		Dieldrin		Heptachlor Epoxide		Oxychlordane	
		Number	Proportion	Number	Proportion	Number	Proportion
0	540	236	.437	79	.146	119	.220
1	458	173	.378	63	.138	72	.157
2	252	82	.325	38	.151	38	.151
3	111	35	.315	9	.081	13	.117
4	43	13	.302	6	.140	5	.116
5 or more	32	9	.281	2	.063	3	.094
TOTAL	1436=N*	548=T**	.382=$\bar{p}$***	197=T	.137=$\bar{p}$	250=T	.174=$\bar{p}$

* N = Total number of mothers involved in the study.

** T = Total number of mothers with more than 100 ppb of the chemical in their milk.

***p = T/N = proportion of mothers with level of the chemical higher than 100 ppb.

Table 28. DIELDRIN LEVELS IN MILK OF NURSING MOTHERS BY AGE GROUP. N = 1436
Fat Adjusted Levels

Human Milk Study 1975

Dieldrin Levels in PPB		Years of Age						
		UNKNOWN	15-19	20-24	25-29	30-34	35+	Row Total
0	N=	1	3	14	29	11	3	61
Trace	N=	2	10	60	96	34	13	215
1 - 50	X=	0	43.179	39.834	40.285	39.872	44.223	40.392
	N=	0	5	27	52	24	5	113
	SD=	0	7.687	9.089	9.503	8.311	2.765	8.832
51 - 75	X=	61.636	65.373	63.034	64.172	63.330	63.820	63.689
	N=	3	15	75	92	44	11	240
	SD=	10.369	7.089	7.024	6.831	7.297	7.272	7.011
76 - 100	X=	86.800	89.140	88.447	88.407	85.863	86.902	87.902
	N=	2	15	78	101	45	18	259
	SD=	9.828	7.370	7.965	7.586	7.792	6.453	7.665
101 - 150	X=	101.594	117.492	122.485	125.927	123.485	118.337	123.793
	N=	1	10	80	116	47	11	265
	SD=	0	14.606	13.469	15.037	16.059	16.924	14.932
151 - 250	X=	0	206.157	190.276	189.844	182.842	188.934	189.937
	N=	0	12	41	75	28	3	159
	SD=	0	33.039	27.282	29.892	27.211	40.523	29.312
251 - 500	X=	395.946	260.714	348.074	312.234	325.204	263.071	327.212
	N=	1	1	26	29	23	1	81
	SD=	0	0	71.583	53.437	71.518	0	66.310
>500	X=	0	581.980	1619.902	952.964	1157.912	3164.720	1358.123
	N=	0	4	9	16	9	5	43
	SD=	0	55.515	1355.624	482.584	783.069	5121.379	1892.067
Column Total	* $\bar{X}$=	122.293	141.468	160.509	145.688	165.675	378.566	164.246
	N=	10	75	410	606	265	70	1436
	*SD=	121.918	131.042	330.674	186.097	267.924	1669.825	436.264

* - $\bar{X}$ and SD and computed only for levels above the sensitivity level, 1 ppb.

Table 29. HEPTACHLOR EPOXIDE LEVELS IN MILK OF NURSING MOTHERS BY AGE GROUP. N = 1436
Fat Adjusted Levels

Human Milk Study 1975

Heptachlor Epoxide Levels in PPB		Years of Age						
		UNKNOWN	15-19	20-24	25-29	30-34	35+	Row Total
0	N=	2	2	27	45	14	5	95
Trace	N=	1	20	126	189	77	22	435
1 - 50	$\bar{X}$=	0	40.286	37.123	38.127	35.916	37.566	37.483
	N=	0	26	89	105	70	13	303
	SD=	0	6.776	8.998	8.383	9.579	7.704	8.738
51 - 75	$\bar{X}$=	57.960	59.158	61.539	62.543	60.593	58.174	61.458
	N=	4	11	66	111	47	14	253
	SD=	4.104	4.204	7.235	7.663	6.735	7.904	7.295
76 - 100	$\bar{X}$=	78.176	85.775	87.290	88.272	87.197	88.979	87.604
	N=	2	7	50	63	21	10	153
	SD=	2.580	9.377	7.618	7.504	8.176	8.421	7.738
101 - 150	$\bar{X}$=	120.000	141.667	125.615	123.964	119.044	137.115	124.236
	N=	1	2	27	48	18	3	99
	SD=	0	11.785	15.792	13.464	13.782	10.395	14.375
151 - 250	$\bar{X}$=	0	187.140	187.962	203.433	185.630	184.927	194.885
	N=	0	5	15	31	10	3	64
	SD=	0	18.925	25.853	28.354	25.655	40.183	27.746
251 - 500	$\bar{X}$=	0	370.961	318.282	360.632	366.134	0	349.666
	N=	0	2	8	10	6	0	26
	SD=	0	98.783	75.674	60.478	62.723	0	67.543
>500	$\bar{X}$=	0	0	745.364	1146.555	1261.469	0	1074.986
	N=	0	0	2	4	2	0	8
	SD=	0	0	290.429	626.471	1009.085	0	607.964
Column Total	* $\bar{X}$=	72.599	80.369	85.518	99.344	91.448	73.458	91.360
	N=	10	75	410	606	265	70	1436
	*SD=	23.178	75.129	86.270	139.754	163.255	42.947	125.225

* - $\bar{X}$ and SD are computed only for levels above the sensitivity level, 1 ppb.

Table 30. OXYCHLORDANE LEVELS IN MILK OF NURSING MOTHERS BY AGE GROUP, N = 1436
Fat Adjusted Levels

Human Milk Study 1975

Oxychlordane Levels in PPB		Years of Age						
		UNKNOWN	15-19	20-24	25-29	30-34	35+	Row Total
0	N=	0	2	9	31	6	4	52
Trace	N=	5	14	100	129	57	18	323
1 - 50	X=	0	39.571	39.778	39.518	38.338	35.022	39.108
	N=	0	17	64	77	59	9	226
	SD=	0	8.766	7.358	8.802	9.188	9.397	8.528
51 - 75	X=	58.694	59.751	61.705	63.089	62.695	62.028	62.360
	N=	4	18	95	150	61	18	346
	SD=	10.396	6.315	5.765	6.706	7.451	7.112	6.664
76 - 100	X=	0	88.864	86.545	87.036	87.209	89.335	87.128
	N=	0	14	72	104	38	11	239
	SD=	0	7.384	7.640	7.645	7.279	7.595	7.560
101 - 150	X=	0	120.462	122.221	119.447	118.852	111.977	120.006
	N=	0	7	43	67	25	4	146
	SD=	0	13.953	13.635	12.402	15.087	10.244	13.243
151 - 250	X=	0	177.273	188.285	188.539	188.173	196.604	188.320
	N=	0	2	22	38	14	2	78
	SD=	0	32.141	30.036	28.213	34.691	59.479	29.934
251 - 500	X=	281.022	294.737	324.029	317.601	348.827	399.288	333.706
	N=	1	1	4	6	2	3	17
	SD=	0	0	35.592	44.678	9.433	79.374	53.651
>500	X=	0	0	640.069	1909.189	1166.503	731.579	1389.768
	N=	0	0	1	4	3	1	9
	SD=	0	0	0	2531.009	632.579	0	1667.421
Column Total	* $\bar{X}$=	103.159	76.014	86.289	103.739	95.065	108.019	95.786
	N=	10	75	410	606	265	70	1436
	*SD=	99.835	44.845	59.280	274.306	154.470	127.793	195.090

* - $\bar{X}$ and SD are computed only for levels above the sensitivity level, 1 ppb.

Table 31. Number and Proportion of Nursing Mothers with Fat Adjusted Levels of Dieldrin, Heptachlor Epoxide, or Oxychlordane Greater Than 100 ppb Classified by Age Group.

Human Milk Study 1975

Age Group	Total Number of Mothers	Mothers with Fat Adjusted Levels Greater Than 100 ppb					
		Dieldrin		Heptachlor Epoxide		Oxychlordane	
		Number	Proportion	Number	Proportion	Number	Proportion
15 - 19	75	27	.360	9	.120	10	.133
20 - 24	410	156	.380	52	.127	70	.171
25 - 29	606	236	.389	93	.153	115	.190
30 - 34	265	107	.404	36	.136	44	.166
35 - 45	70	20	.286	6	.086	10	.143
Unknown	10	2	.200	1	.100	1	.100
TOTAL	1436=N*	548=T**	.382=$\bar{p}$***	197=T	.137=$\bar{p}$	250=T	.174=$\bar{p}$

* N = Total number of mothers involved in the study who gave their age.

** T = Total number of mothers with more than 100 ppb of the chemical in their milk.

***$\bar{p}$ = T/N = proportion of mothers with level of the chemical higher than 100 ppb.

Another portion of this study was designed to provide a mechanism to monitor the interview data and at the same time to determine if women who were lactating high levels of pesticides were significantly different from women who were lactating low levels in relation to: 1) pesticide usage, 2) smoking habits, 3) occupational pesticide exposure, 4) social mobility, 5) geographic mobility, 6) home garden pesticide usage, 7) age, 8) education, and 9) lifetime total months of breastfeeding. A total of 102 participants were recontacted by telephone and were asked to give answers to questions that are found in the questionnaire in Appendix H. As previously mentioned, the respondents were selected from those participants who showed the highest levels of pesticides and those who showed the lowest levels of pesticides. The pesticide levels for the high residue group ranged from 150.99 ppb to 2972.73 ppb for all six compounds. The mean pesticide value for all mothers in the high residue group was 623.21 ppb for all six compounds. The low residue group had zero or trace values for all six compounds. The participants were from the five geographic regions and the racial distribution was consistent with the distribution found for all study participants.

Figures 5 and 6 show pesticide usage habits for mothers with low and high residue levels, respectively. The mothers were divided into four groups: those who did not use pesticides, those who used commercial pesticide applicators, those who used consumer pesticide products, and those who used both consumer pesticide products and commercial pesticide applicators. In the low residue group, approximately 18 percent of the mothers did not use pesticides, 46 percent used consumer pesticide products, 8 percent used commercial pesticide applicators and 28 percent used consumer pesticide products and commercial pesticide applicators. These results compared to 3 percent, 30 percent, 10 percent, and 57 percent respectively for the four groups in the high residue group.

The mothers were further divided into three groups by smoking habits as shown in Figures 7 and 8: those who have never smoked, those who had smoked at sometime, and those who presently smoke. In the group who had never smoked, the percentage of mothers who had low pesticide residues (69 percent) compared closely with those who had high residues (62 percent). Those who had smoked at one time during their lives included 13 percent of the mothers with low residues while 31 percent of the mothers with high residues were in this group. On the other hand, 18 percent of the mothers with low residues were in the smoking group, while 7 percent of the mothers with high residues were in this group.

Occupational exposure and non-occupational exposure were also considered. None of the 39 mothers in the low residue group were occupationally exposed, while 11 percent of the high residue group were either exposed occupationally or lived in households where a household member was exposed occupationally. Over 6 percent of the mothers with high residue levels stated that they were frequently exposed to pesticides by a non-household member, while 7.7 percent of the mothers with low residues were exposed to such a person.

Figure 5

Pesticide Usage Habits For Mothers With Low Residue Levels in Quality Control
Human Milk Study 1975
N= 39

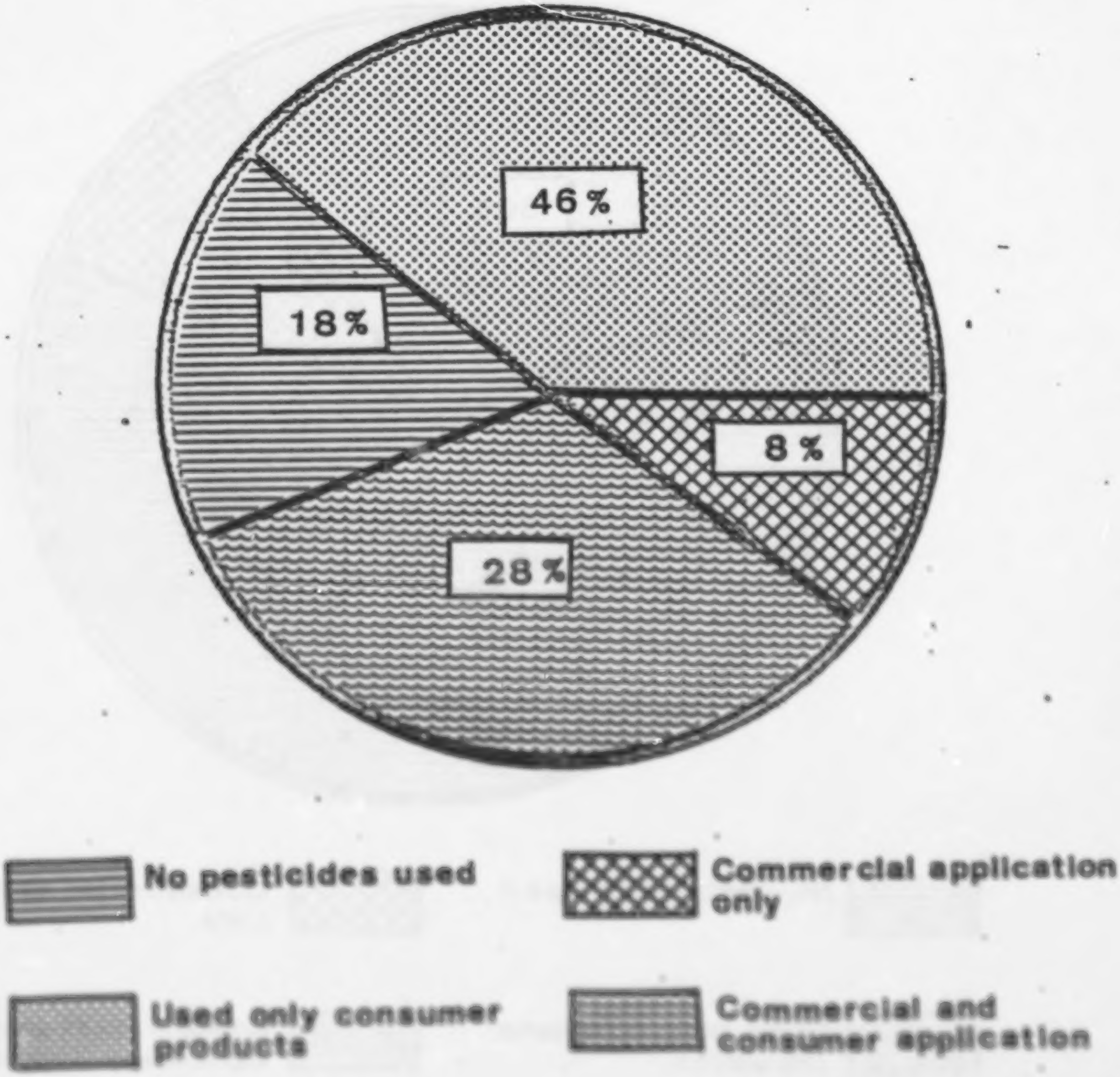


Figure 6

Pesticide Usage Habits For Mothers With High Residue Levels In Quality Control
Human Milk Study 1975
N=63

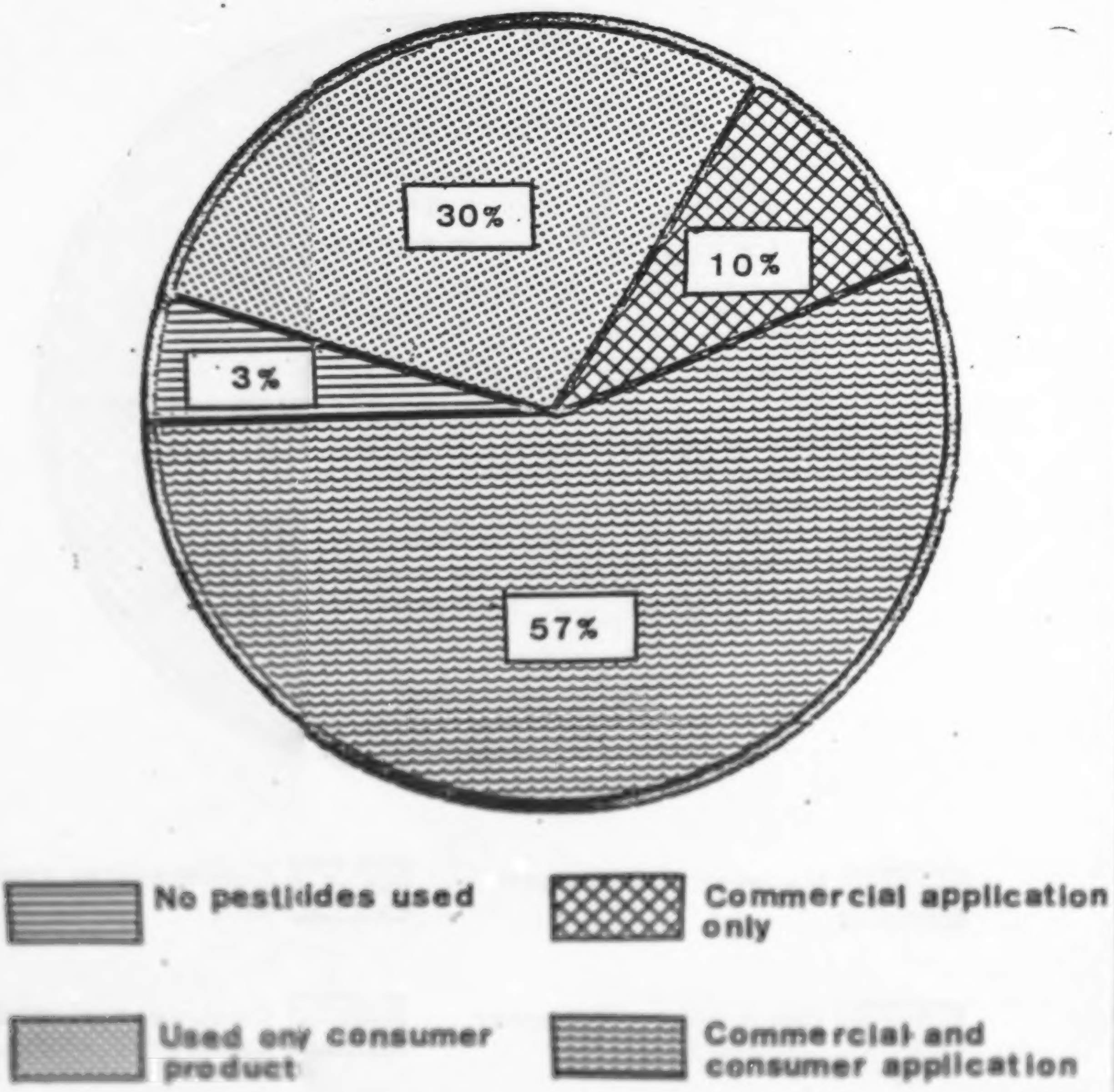


Figure 7

Smoking Habits For Mothers With Low Residue
Levels In Quality Control
Human Milk Study 1975

N = 39

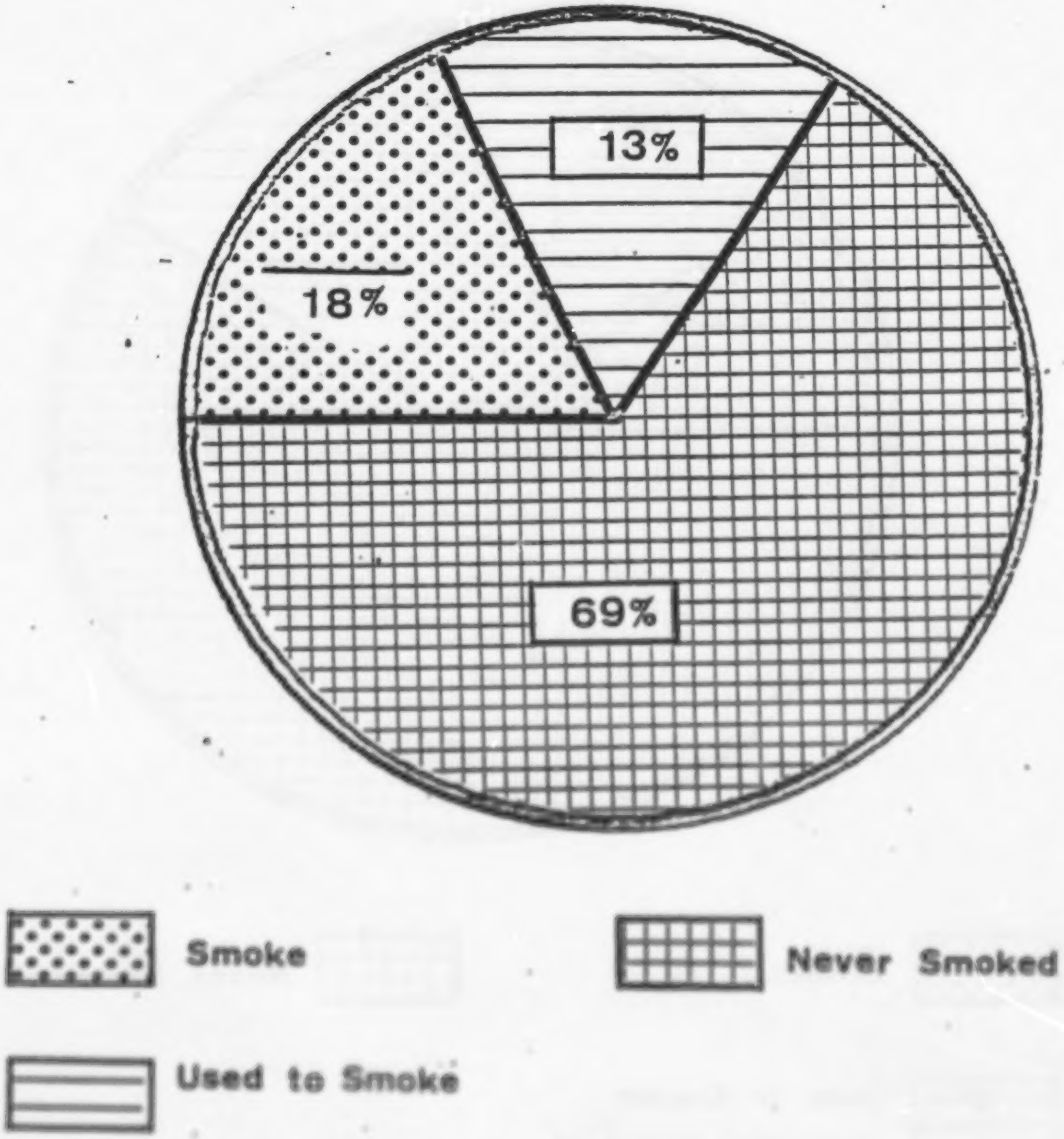
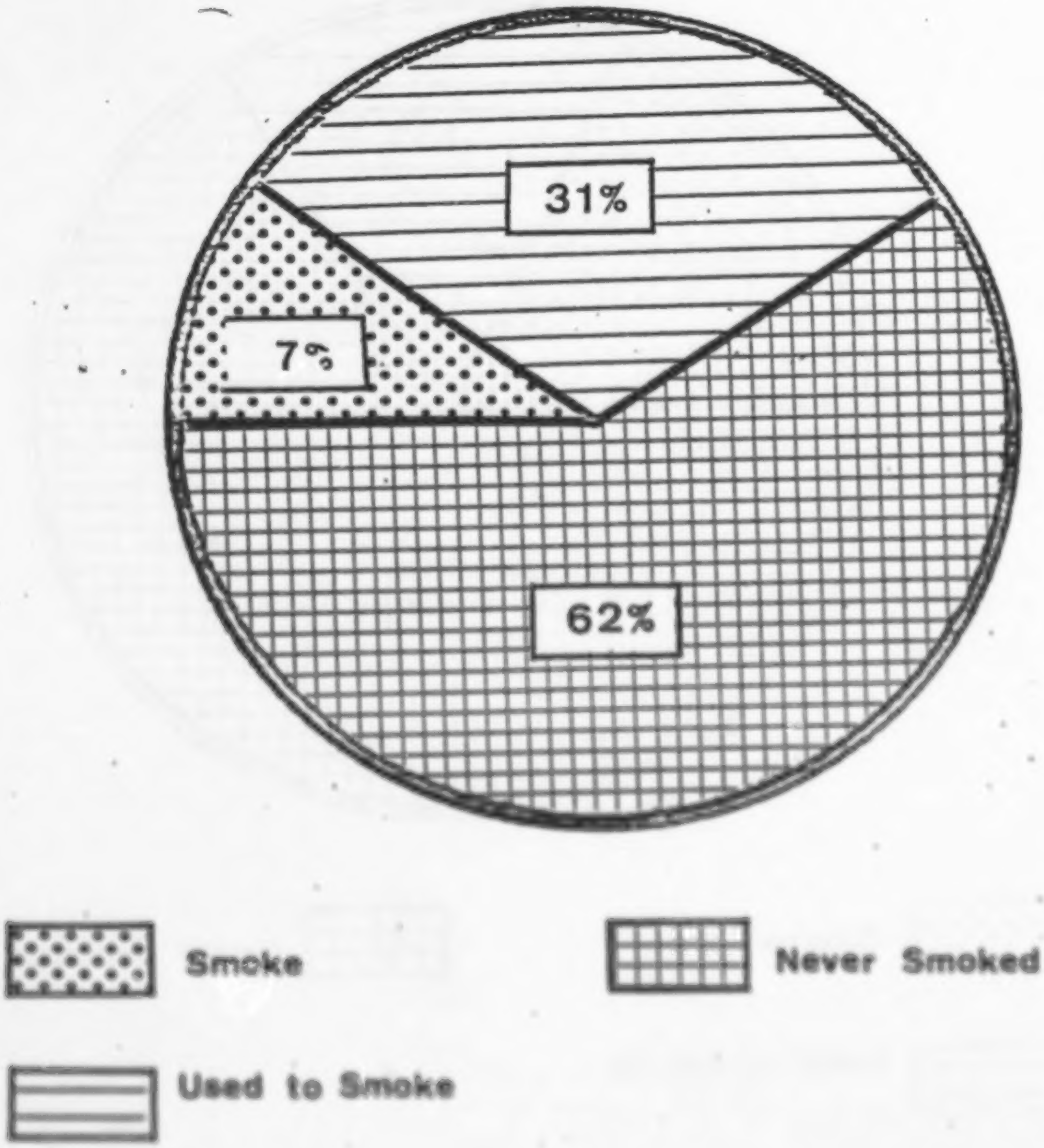


Figure 8

Smoking Habits For Mothers With High Residue Levels In Quality Control
Human Milk Study 1975
N = 63



The recontacted mothers were asked about their father's occupation and education as well as the head of the household's occupation and education. From this information, the Two Factor Index of Social Position was used to determine the social mobility of each mother. It was found that 52 percent of the mothers with high pesticide residue levels were socially mobile upward while 62 percent of the low residue group were socially mobile upward.

Geographic mobility was determined for each mother in relation to high and low pesticide usage areas for the past ten years. Many of the mothers in both the low residue group and the high residue group have lived in areas with high pesticide usage for the majority of the past ten years. By comparison, the group with low residues spent 50 percent of their time in a high usage area while the high residue group spent 64 percent of their time in a high usage area. The pesticide usage was also determined for the mother's place of birth, but the two groups showed no difference.

The use of home grown vegetables was another point of comparison between the low and high pesticide residue groups, but no difference was found.

The mother's age, education, and the total months that she had breastfed before the sample collection were other factors considered. There was a difference of only 4 months in the mean ages of the groups, the low residue group being older than the group with the high pesticide residues. The education level of the two groups was identical, but there was a difference in the total months that the mothers had breastfed.

On the average, the mothers with high residue levels had breastfed during their lifetime 8.0 months while mothers with low residue levels had breastfed during their lifetime 13.2 months.

Discussion

This research is the largest single effort ever undertaken to determine the levels of organochlorine pesticides in the milk of nursing mothers. In this study a total of 1436 samples were collected from women giving birth in 150 U.S. hospitals. When the research was originally designed, it was thought that it might be possible to estimate the levels of organochlorine pesticides in human milk among mothers giving birth in general care hospitals in the United States. However, due to several problems in collection, the sample does not necessarily represent the total population of mothers giving birth in U.S. hospitals.

Observing this study, one must consider the topic of what socioeconomic group of United States women nurse their children. Prior to initiating the study, we received much information regarding the nursing pattern in this country. Some believed nursing to be a characteristic of low socioeconomic groups, others believed it to be a middle class syndrome, and yet others believed nursing to be widespread and found throughout all socioeconomic groups. After contacting 150 hospitals and 1436 mothers, we are of the opinion that the nursing pattern in the United States is quite variable. For example, other hospitals had to be substituted for Charity Hospital in New Orleans, because not enough nursing mothers from Charity could be obtained to fulfill the sample quota. On the other hand, little difficulty was encountered in some rural areas since approximately every mother who gave birth nursed the child. In general, the middle socioeconomic group provided a larger number of milk samples for this study.

Results of this study on organochlorine pesticide residues in nursing mother's milk illustrate that dieldrin, oxychlordane, and heptachlor epoxide are quite ubiquitous compounds. Dieldrin was identified in greater than 80 percent of all milk samples collected. In addition, greater than 63 percent of the samples contained heptachlor epoxide above the detection limit while approximately 74 percent of the samples had oxychlordane residue levels greater than 1 ppb. Although the mean level of these three compounds in milk on a fat adjusted basis was low, the range of values from 0 to 12,300 ppb was wide. Frequently, the same person had a high value for more than one compound; thus each organochlorine compound cannot be considered on a single compound basis, but rather the total body burden on the mother and her nursing child for all the pesticides and their metabolites must be evaluated.

Although several studies have been conducted in the United States to determine the levels of organochlorine pesticides in human milk, most of the studies have analyzed a relatively small number of samples.

Wilson et al. (26), in a study of 138 samples, found a great variation in residue levels between fore and hind milk samples. Not only was it observed that DDT levels diminished with increasing maternal age, but also that milk obtained after nursing contained significantly more DDT than milk collected prior to nursing.

In this study, considerable differences were noted in the mean levels of the three compounds found in the milk of mothers living in the five regions. Milk samples collected from women living in the southeastern United States had the highest mean levels of dieldrin, heptachlor epoxide, and oxychlordane. Nursing mothers from the northwestern United States had the lowest mean levels of all three compounds. On a fat adjusted basis, women living in the southwestern United States excreted the second highest levels of oxychlordane and dieldrin, while women from the northeastern United States excreted the second largest levels of heptachlor epoxide.

Regional differences were apparent in the distributions of fat adjusted levels of dieldrin, heptachlor epoxide, and oxychlordane (respectively; Tables 10, 11, and 12 and bar graphs in Figures 9, 10, and 11). For each pesticide, chi-square analysis yielded a P-level value less than .001. Combination of the fat adjusted levels into "Low" (less than 1 ppb), "Medium" (1 to 100 ppb), and "High" (more than 100 ppb) for each pesticide allows regional differences to be explored graphically through a technique suggested by Snee (34). In particular, Figures 12, 13, and 14 present 95 percent confidence regions of the proportions of Low, Medium, and High fat adjusted levels for each of the five geographic areas. When two confidence regions do not overlap, the distributions of proportions for the two geographic areas were significantly different.

Thus, with respect to dieldrin, the Northeast and Northwest are significantly different and both were significantly different from the Southeast, Midwest, and Southwest. From Figure 12, one could see that the Southeast, Midwest, and Southwest have considerable higher proportions of "High" fat adjusted levels of dieldrin than did the Northeast and Northwest; furthermore, the Northeast had the highest proportion of "Low" fat adjusted levels of dieldrin.

Figure 9. Distribution of Fat Adjusted Dieldrin Levels Within Each Geographic Region. Human Milk Study 1975.

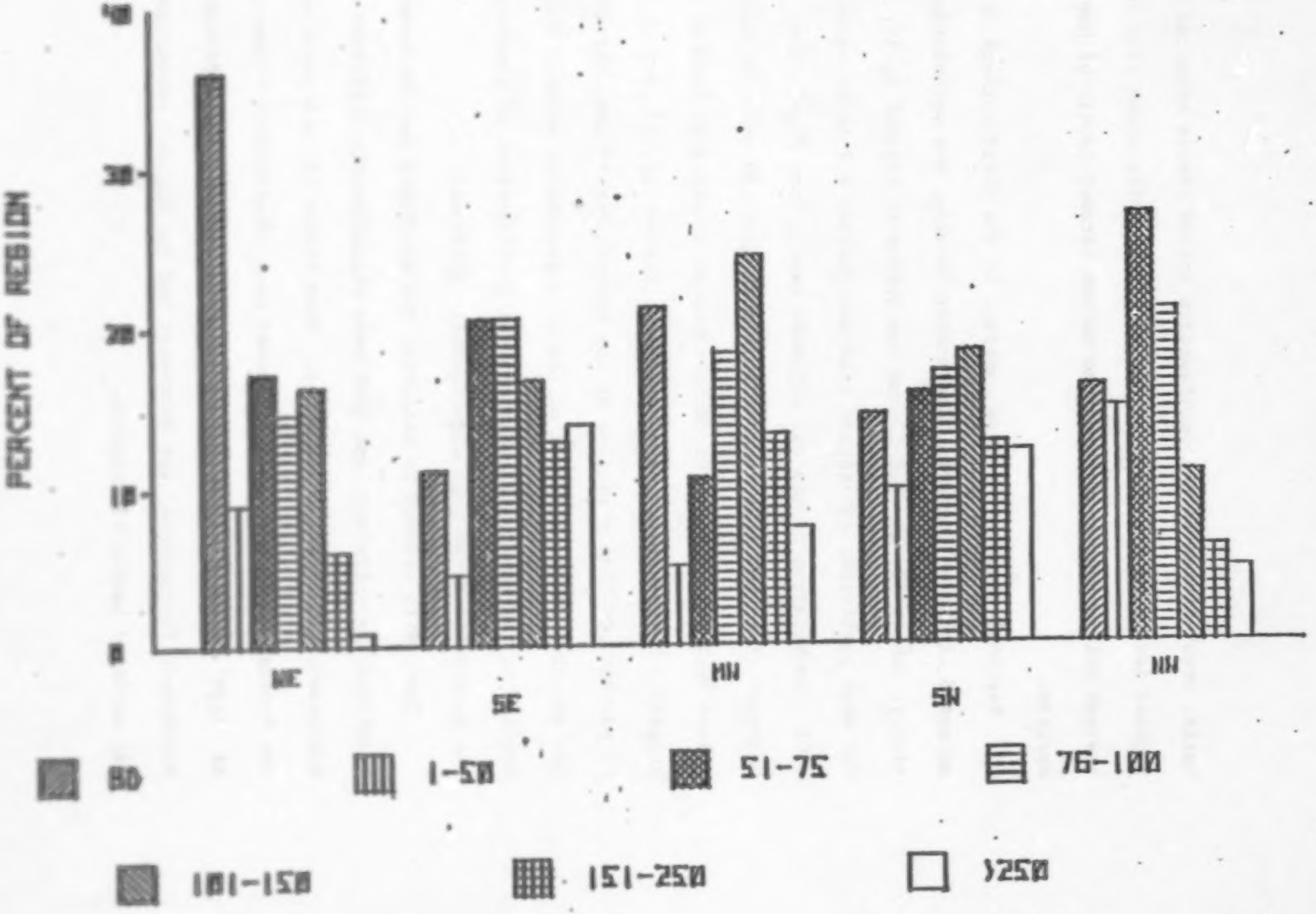


Figure 10. Distribution of Fat Adjusted Heptachlor Epoxide Levels Within Each Geographic Region. Human Milk Study 1975.

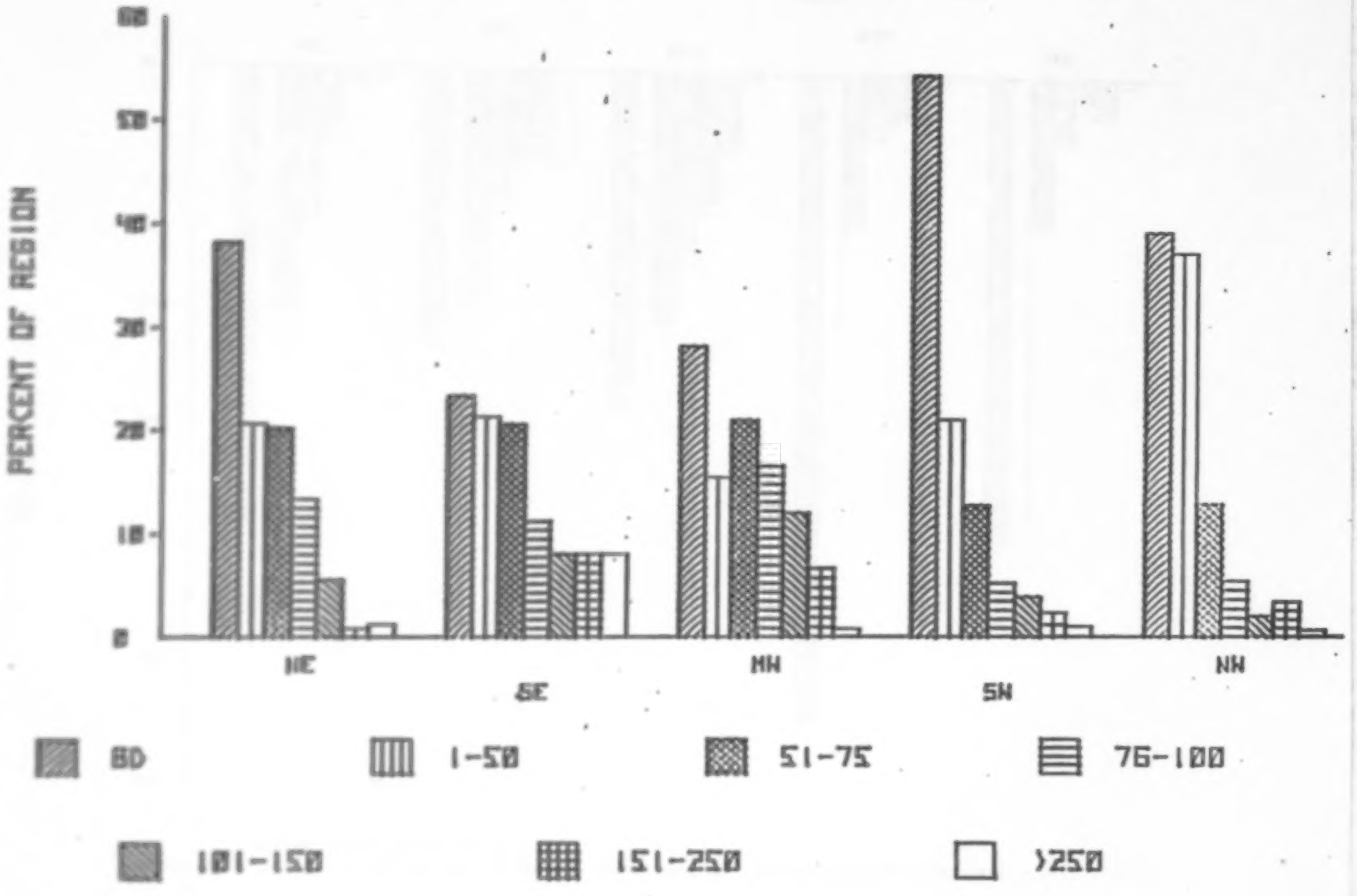


Figure 11. Distribution of Fat Adjusted Oxychlordane Levels Within Each Geographic Region. Human Milk Study 1975.

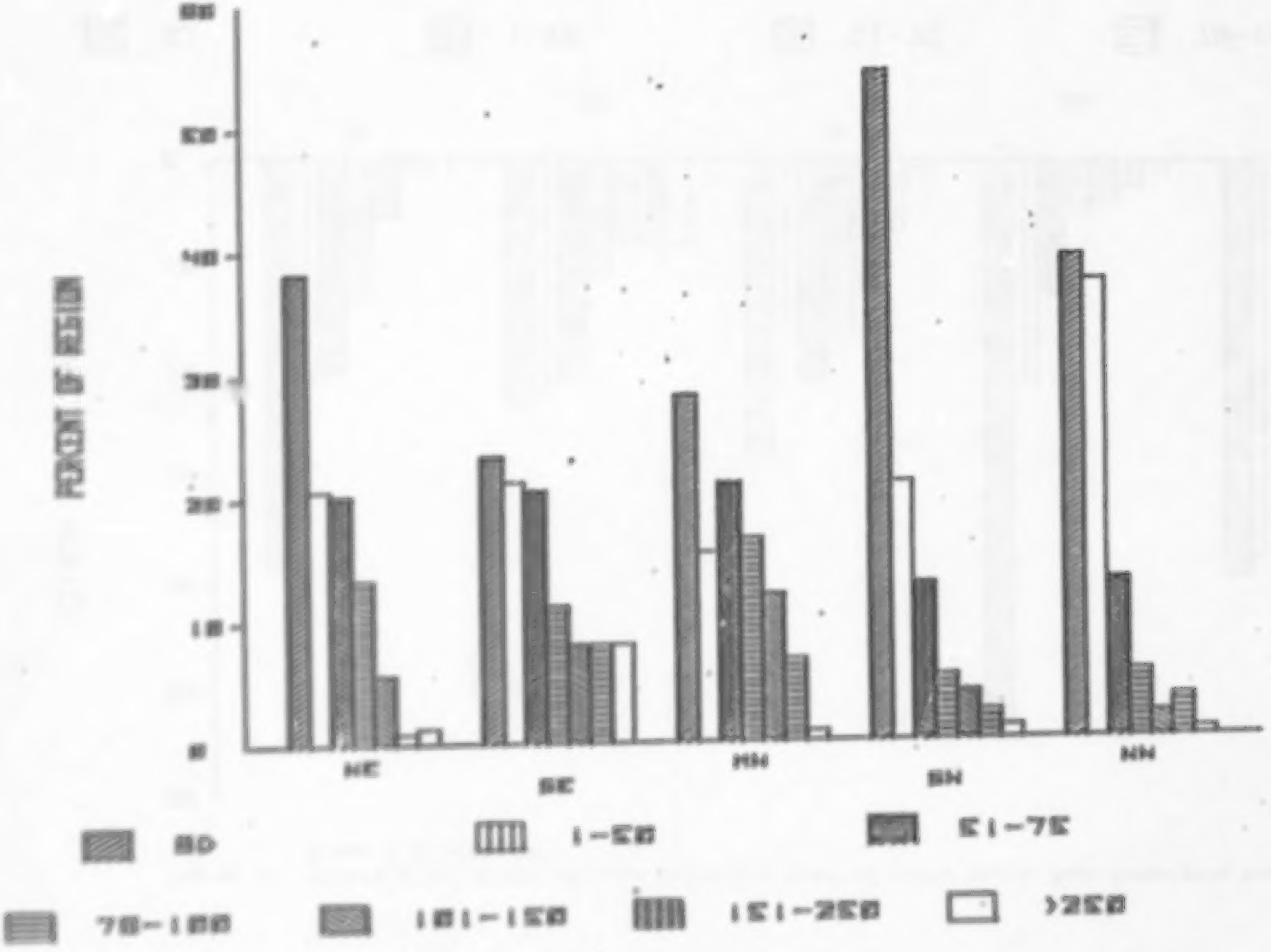


Figure 12: 95% Confidence Regions for Proportions of Low, Medium, and High Fat Adjusted Dieldrin Levels in Mothers' Milk within Geographic Regions. Human Milk Study 1975

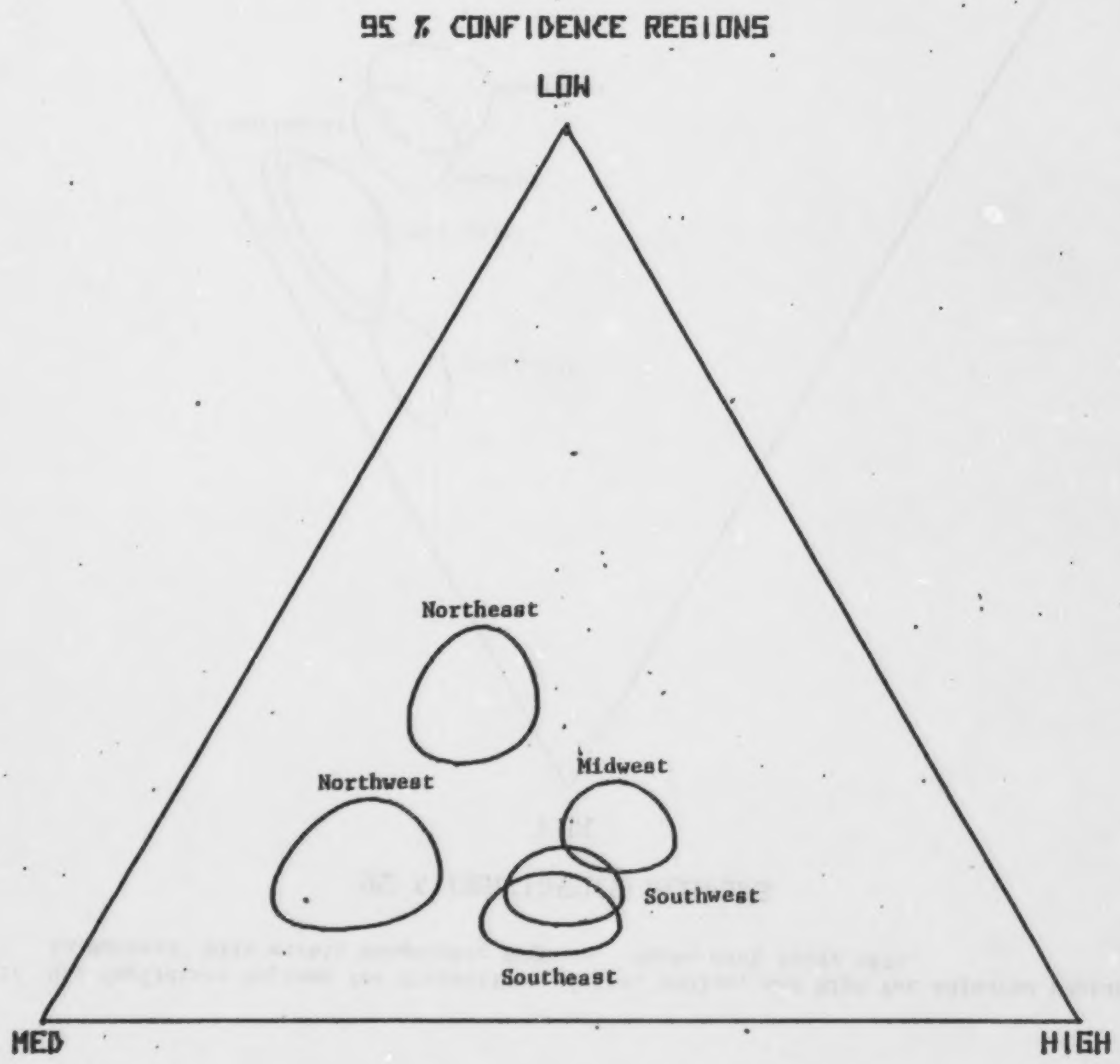


Figure 13: 95% Confidence Regions for Proportions of Low, Medium, and High Fat Adjusted Heptachlor Epoxide in Mothers' Milk within Geographic Regions. Human Milk Study 1975.

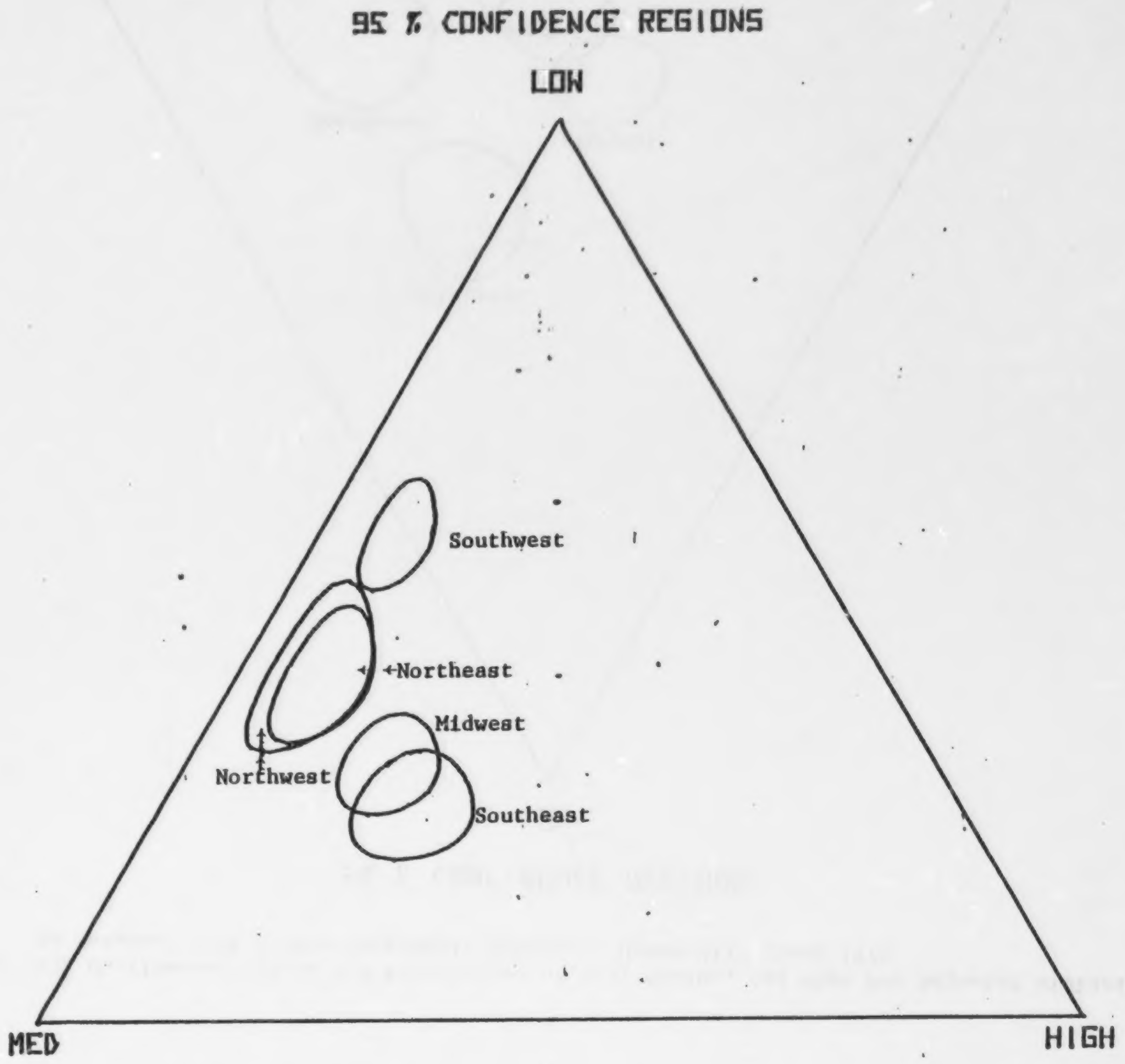
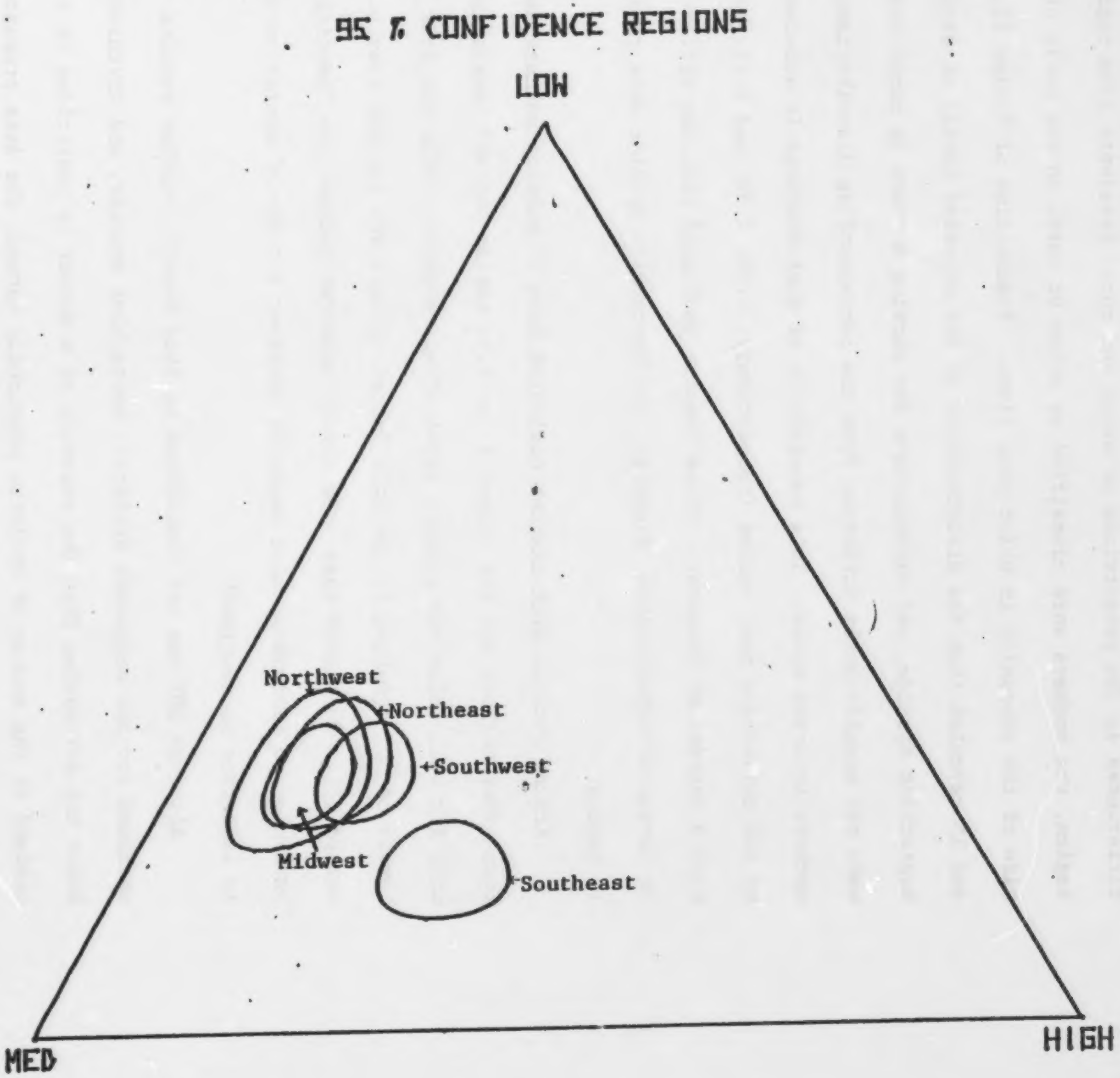


Figure 14: 95% Confidence Regions for Proportions of Low, Medium, and High Fat Adjusted Oxychlordane Levels in Mothers' Milk within Geographic Regions Human Milk Study 1975.



To determine if the geographic differences in levels were due to differences in the proportions of urban and rural residents from region to region, the mothers were classified as urban or rural on the basis of the size of the community in which they lived. Examination of Tables 13, 14, and 15 revealed that the distributions of fat adjusted levels of dieldrin, heptachlor epoxide, and oxychlordane for nursing mothers in rural areas were not significantly different from the corresponding distributions for mothers in urban areas. This homogeneity of distributions is substantiated by the chi-square test values (respectively, 5.90, 1.83, and 6.12, each with 8 degrees of freedom). These results indicated that the differences in levels of oxychlordane, dieldrin, and heptachlor epoxide were regional in nature.

Kroger studied milk samples collected from 37 nursing mothers and found that mothers who had nursed 3 or more babies had DDT levels in their milk fat well below the average level of all mothers, while the four highest levels of DDT occurred in the milk fat of mothers who had not previously nursed (8). He stated that this result occurred because the "pesticide burden of an individual must decrease whenever a route of excretion such as lactation is provided".

Although DDT was not considered in this report, similar results were obtained for the compounds dieldrin, heptachlor epoxide, and oxychlordane. Under the assumption that the exposure of a mother to pesticides is independent of the number of children previously nursed, the data presented in this report strongly indicated that the proportion of mothers with fat adjusted levels of dieldrin, heptachlor epoxide, or oxychlordane greater than 100 ppb were linearly related to the number of children previously nursed. The data indicated that the proportion of mothers with high levels of any of these chemicals tended to decrease as the number of children previously nursed increased. The slopes of the lines for dieldrin and oxychlordane were significantly negative. The slope of the line for the proportion of mothers with high levels of heptachlor epoxide was also negative but was not significant at the .05 level.

The data also suggested a linear relationship between mothers with high levels of dieldrin, heptachlor epoxide, or oxychlordane in their milk (on a fat adjusted basis) and the number of children they have had. These relations were not surprising considering the high correlation between the number of children and the number of children previously breastfed ($r = .85$).

The effect of pesticides in mothers milk on infants and nursing mothers is not well documented. Results of this study suggest that a mother who lactates through several births actually has lower pesticide levels in her milk than a mother who is nursing her first child. From this standpoint nursing may be beneficial to the mother. In the case of the infant the results are not clear. Although the levels of dieldrin, oxychlordane, and heptachlor epoxide are quite low in mothers milk throughout the United States, there are a large majority of women lactating these contaminants. In some instances nursing infants are being exposed to higher levels of these pesticides than the current tolerance levels in dairy milk. Because chlordane and heptachlor are both on the suspect list as potential carcingens, infant exposure to these chemicals may be harmful. Therefore,

because these compounds have been used in the country for well over two decades, an epidemiological investigation to determine the infancy nursing profile of people under 30 with respect to cancer is certainly worthy of consideration.

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APPENDICES

Appendix A

A set of directions on the collection, storage, and shipment of samples were prepared and given to all nurses or La Leche League representatives participating in the study (Directions 1 and 2). Directions for the completion of the participant questionnaire form were also included (Directions 3). The nurses were requested to have each mother sign a "Consent to Serve as a Subject in Research" form (Consent Form) prior to the collection of milk.

Appendix A

Directions 1

DIRECTIONS FOR COLLECTION OF HUMAN MILK SAMPLES

To insure accurate analysis of your sample, it is important to follow these directions carefully.

1. Prior to collecting the sample, wash your hands with soap and water. However, the breast should be washed with plain water only.

2. The bottle has been thoroughly cleaned. Please avoid touching the inside of the bottle and cap during collection.

3. Manually express the milk into the bottle. (PLEASE, DO NOT USE A BREAST PUMP). Minimum volume required is 1/2 oz. or to the first mark on the bottle; but, if possible, fill the bottle to the third mark (1 1/2 oz.).

4. Several collections may be required to obtain the necessary volume. Please refrigerate between collections.

5. Freeze the sample when you have the required volume.

Appendix A

Directions 2

NURSES DIRECTIONS

Collection

1. Be certain only the containers provided are used to collect the sample.

2. If the sample cannot be obtained during the initial contact, be certain to instruct and provide the mother with the directions for collection and with a specimen container. Review the directions with the mother.

3. Make arrangements with the mother to pick up the sample.

4. Both the bottles and the information cards are numbered. Please be sure to check to see that the numbers correspond before giving the specimen bottle to the participating mother.

5. After the sample has been obtained, cool immediately and freeze as soon as possible.

6. Do not allow the sample to thaw.

Packaging and Shipping

1. Frozen samples should be wrapped in cheesecloth and encased in the individual Styrofoam containers provided.

2. Place the small containers in the large Styrofoam box and fill the remainder of the box with dry ice.

3. Use the straps provided to close the box for shipping. Ship with the labels and instructions provided.

Appendix A

Directions 3

QUESTIONNAIRE FORM DIRECTIONS

The Human Milk Study questionnaire form has been designed to obtain pertinent epidemiological information about mothers participating in the study. It is imperative that complete and accurate data are obtained by the interviewer; otherwise, the final analyses and interpretations may be seriously affected.

The questionnaire form is to be completed only by project personnel or by the nurse contacted at the participating hospital. The mother *is not* to complete the form herself. If the hospital nurse is to complete the form, the project representative shall review the instructions with her (leave instruction sheet with her also) to help insure her understanding of the questions and their importance.

Step

1. Enter name of selected hsopital in which the participating mother gave birth.

2. The sample number on a form *must* correspond to the etched number appearing on one of the glass sampling jars. Each participating mother must have one card and one jar with same number. Please double-check to make sure that these numbers do correspond. If the sample number is not entered into form, the analysis of the milk specimen will be meaningless.

3. Enter mother's name and home address. We *must* have the city and state listed.

4. Check the appropriate space to indicate if participant resides in an urban or rural area. Rural should only be checked if participant lives on a farm or ranch.

5. Enter the exact age of participant. If not obtainable, please make a reasonable guess and indicate this as, eg., *35?*.

6. The ethnic group of the mother should be identified as one of the following categories: white, black, oriental, American Indian, Spanish American, Puerto Rican, or other.

7. Please check either yes or no to indicate if the mother is *presently* smoking.

8. Enter the mother's current occupation or the occupation held prior to giving birth.

9. Enter number of siblings (living brothers and sisters) of the newborn child and the number of these breast fed.

10. Enter month, day, and year of last child's birth.

Directions 3 (continued)

11. Enter present occupation of household head and indicate type of work; eg., farmer, fruit or laborer; construction; etc.

12. Check yes or no to indicate if anyone presently living in the mother's household (i.e., son, husband, etc.) is presently employed in any occupation that uses pesticides; eg., farmer, pest control operator, greenhouse worker, pesticide formulator, etc.

13. Please enter date when the milk sample was collected and if the sample was collected before, during, or after the breast feeding of the baby.

14. Indicate all the kinds or names of medications (including vitamins, aspirins, antibiotics) that the mother is presently taking.

15. Indicate the highest education grade level attained by the household head.

16. The interviewer must sign form when completed.

Appendix A

Consent Form

CONSENT TO SERVE AS A SUBJECT IN RESEARCH

I consent to serve as a subject in the research investigation entitled:

National Study to Determine Levels of Chlorinated Hydrocarbon Insecticides in Human Milk

The nature and general purpose of the experimental procedure and the known risks involved have been explained to me by ______________________. He/She is authorized to proceed on the understanding that I may terminate my service as a subject in this reasearch at anytime I so desire.

I understand the known risks are: . There are no known risks.

I understand also that it is not possible to identify all potential risks in an experimental procedure, and I believe that reasonable safeguards have been taken to minimize both the known and the potential but unknown risks.

Witness ______________________ (Investigator)

Signed ______________________ (Subject)

Date of birth of Subject ______________________

Date ______________________

TO BE SIGNED IF SUBJECT IS A MINOR

I authorize ______________________ to become a subject for the research proposal as outlined above. The nature and general purpose of the project has been satisfactorily explained to me by ______________________ and I am satisfied that proper precautions are to be observed.

Signed ______________________ (Parent or Guardian)

Date ______________________

(To be Retained by the Principal Investigator)

Appendix B

The Human Milk Study's participant questionnaire form and the milk pesticide residue analysis report form (Fig. 1) were designed to be easily coded for the transfer of data to computer cards for storage, analysis, and retrieval. The field epidemiologists and chemists were instructed at training sessions on the proper completion of the report forms; however, personnel from the Colorado Center were the only personnel allowed to assign code numbers to the recorded information. Improperly coded information could seriously compromise the accuracy of the study; therefore, it was important that complete and accurate data were obtained and correct coding procedures followed. The following is a description of some of the information desired on the forms.

The name of the selected hospital in which the mothers gave birth was recorded so that a complete record of the study's progress could be maintained. A participant was considered urban if she resided within the city limits of any municipality, town or city and rural if she resided on a farm or a ranch. Since the age of a participant is an important item to obtain in any epidemiologic study, each participant was asked her age. The ethnic groups of the mother were divided into the following categories: White, Negro, Oriental, American Indian, Mexican American, Puerto Rican, and others. The mother's current occupation or the last occupation that she held prior to giving birth and the present occupation of the household head were also recorded. The household head's occupation and highest education grade level were used to establish a Hollingshead Index number for each of the participants. It was also necessary to determine if anyone presently living in the mother's household was employed in any occupation that uses pesticides; this would help account for any unusual residues. All types and names of medication that the mother was taking at time of sampling were also recorded.

The pesticide residue analysis report forms for the milk samples were completed by the chemists performing the analyses. The sample number on the report form had to correspond exactly to the sample number placed on the interview questionnaire form. The participant's I.D. included the nursing mother's name and address. The chemist was to indicate the condition of the milk sample when it arrived to the laboratory; e.g., frozen, thawed, curd formation, etc., date received, date analyzed, weight analyzed, and percent lipid of the sample. All pesticide residues found in each milk sample were recorded onto the cards in parts per billion.

Appendix B

Figure B - 1

HUMAN MILK STUDY

Hospital ______
Milk Volume ______ Sample Number ______
Mother's Name: ______
Address: ______
______
Class: Urban ______ Rural ______
Age: ____ Ethnic Group: ______ Smoker: Yes ____ No ____
Occupation: ______
Number of siblings: ______ How many were breast fed? ______
Date of Baby's Birth: ______
Occupation of head of household(hh): ______
Does anyone in hh work with pesticides? Yes ______ No ______
Date of sample collection: ______
When was the sample collected? Before feeding ______
After feeding ______ During the feeding ______
Are you presently taking any medications? ______
If so, what kind? ______
Highest grade level attained by head of household: ______
Interviewer: ______

Office Use Only
Card Code 1
Form ID
3 __ __ __ __ __ __ __ __ __ __
14 __ __ 17 __ __ __ __
U 22 R 23 25 __ __
28 Y 30 N 31
33 __ 36 __ 39 __
42 __/__ __/__ __
49 __ Y 52 N 53
55 __/__ __/__ __
62 B __A __D
66 __ 69 __ 72 __
75 __

MILK PESTICIDE RESIDUE ANALYSIS REPORT

Sample No. ______ Condition of Sample ______
Participant I.D. ______
______ Date Recv'd ______
Used established analytical procedures: YES ______ NO ______
Wt. analyzed ______ mg; % Lipid ______ Date analyzed ______
Laboratory ______ Chemist ______

Card Code 2
ID
3 __ __ __ __ __ __ __ __ __
15 17 __ __/__ __/__ __
24 26 __ __ __ __
32 __ __ __
37 __/__ __/__ __
44 __ __

Code ID Number of Pesticide Residues __ __ 14

Code	Pesticide Residue	<	Amount	ppm	ppb	CL	Code	Pesticide Residue	<	Amount	ppm	ppb	CL
CT 31 15							49 41	Dieldrin		.			
37 17	pp'DDT		____ . __				51 53	Heptachlor		____ . __			
38 29	op'DDT		____ . __				52 65	Hept. Epox.		____ . __			
39 41	pp'DDE		____ . __				CT 33 15						
41 53	pp'DDD		____ . __				67 17	Chlordane		____ . __			
44 65	α-BHC		____ . __				85 29	PCB's		____ . __			
CT 32 15							86 41	Oxychlor.		____ . __			
45 17	β-BHC		____ . __				AE 53	HCB		____ . __			
46 29	γ-BHC		____ . __				AR 65	TNC		____ . __			

Appendix C

NATIONAL STUDY TO DETERMINE LEVELS OF CHLORINATED HYDROCARBON INSECTICIDES IN HUMAN MILK

Training Course - April 8 & 9, 1975

1. Handout of Background Information
2. EPA Interest
3. Study Design - Work Session: Dr. Eldon Savage and Dr. Tom Keefe
4. Nurse's Viewpoint: Sandy Ford
5. Contacting the Hospital and Participants of the Study - Panel Discussion: Fred Applehans, Larry Mounce, Sandy Ford, and Bill Wheeler
6. Sample Collection, Packaging, Storage, Handling & Shipment and Labeling: Betsy Alt
7. Completion of Study Participant Information Card: Fred Applehans
8. Sample Analysis and Quality Control, Clean Up: Virginia Boyes, John Tessari, and Loretta Munsell
9. Statistical Analysis: Gene Johnson
10. Payment: Larry Mounce
11. Reporting Results to Participants - Discussion

Appendix C

PARTICIPANTS

COLORADO

Elizabeth Alt, Medical Technologist
Fred Applehans, Field Epidemiologist
Virginia Boyes, Research Technician
Sandy Ford, Field Epidemiologist/Nurse
Gene Johnson, Statistician
Dr. Thomas Keefe, Statistician
Larry Mounce, Field Epidemiologist
Loretta Munsell, Chemist
Dr. Eldon Savage, Project Director
John Tessari, Chemist & Lab Supervisor
Bill Wheeler, Field Epidemiologist

MICHIGAN

David Dietel, Medical Lab Technician
Adrian Oudbier, Field Investigator

MISSISSIPPI

Dr. Ben Barrentine, Project Director

SOUTH CAROLINA

Ellen Lee, Programmer

Appendix D

CHEMISTS TRAINING COURSE

NATIONAL STUDY TO DETERMINE LEVELS OF CHLORINATED HYDROCARBON INSECTICIDES IN HUMAN MILK
Colorado State University
Fort Collins, Colorado
April 22 & 23, 1975

TUESDAY - APRIL 22, Room 204 Student Center

1. Study Design - Eldon P. Savage
2. Sample Collection, Packaging, Storage, Handling and Shipment and Labeling - Sandy Ford
3. Sample Analyses - Virginia Boyes and Loretta Munsell
    a. Log in
    b. Glassware and Equipment
    c. Procedure
    d. Recovery Levels
    e. Storage Stability
4. Instrumentation - Gas Chromatography - David Spencer
    a. Column Selection
    b. Detector Selection
    c. Operational Parameters
    d. Quality Control
    e. Maintenance
5. Analytical Quality Control - John Tessari
    a. Interlaboratory
    b. Intralaboratory
6. Reporting Forms - Fred Applehans
7. Qualitative Aspects of the Study - Janet Osteryoung
    a. Pooled Samples - Mass Spectrometer, Gas Chromatograph

WEDNESDAY - APRIL 23 - Laboratory, 128 Physiology

1. Laboratory Extraction and Analysis

Appendix D

CHEMISTS TRAINING COURSE

NATIONAL STUDY TO DETERMINE LEVELS OF CHLORINATED HYDROCARBON INSECTICIDES IN HUMAN MILK
Colorado State University
Fort Collins, Colorado
April 22 & 23, 1975

PARTICIPANTS

Colorado

Fred Applehans
Virginia Boyes
Sandy Ford
Loretta Munsell
Janet Osteryoung
Eldon Savage
David Spencer
John Tessari
Bill Wheeler

Michigan

Bob Welch

Mississippi

Jim Cain

South Carolina

Jim Colcolough

Utah

Lynn Thomas

ANALYSIS OF HUMAN MILK SAMPLE

I. Equipment:

1. Centrifuge Bottles - Sargent #S-18460, 200 ml screw cap*
2. Glass wool - Fisher #11-388, PYREX brand 3950
3. Centrifuge - I.E.C. Model EXD, Size 2
4. Separatory funnels - 500 ml, 125 ml, 1000 ml, PYREX brand 6404 or equivalent
5. Chromatographic columns - 25 mm o.d. x 300 mm long, with teflon stopcocks, with or without fitted glass plates, Kontes 420530, size 241
6. Flasks - Round bottom, short neck, PYREX brand, 250 ml, 500 ml. Sargent #S-33885
7. Concentrator Kuderna - Danish fitted with grad. evaporative concentrator tube, available from the Kontes Glass Company, each component bearing the following stock numbers:
   a. Flask, 500 ml, stock #K-57001
   b. Snyder column, 3 ball, stock #K-503000
   c. Steel springs, 1/2", stock #K-662750
   d. Concentrator tubes, 10 ml, size 1025, stock #K-570080
8. Modified Micro-Snyder columns, 19/22, Kontes K-569251
9. Glass beads, 3 mm plain, Fisher #11-312
10. Disposable pipets - Fisher #13-678-5B
11. Volumetric flasks - 100 ml
12. Beakers, 50 ml, Griffin
13. Pipets - Class A, 20 ml
14. Ovens - capable of holding 130°C and 37°C

---

*Teflon Liners - National Scientific size 38, 1 1/2" diameter

II. Reagents:

1. N. Hexane - Pesticide quality, redistilled in glass.
2. Acetone - Pesticide quality, redistilled in glass.
3. Diethyl ether - AR grade, peroxide free, Mallinckrodt #0850 or equivalent. Anhydrous redistilled in glass.
4. Eluting mixture - 6% (6 + 94) - purified diethyl ether - 60 ml is diluted to 1000 ml with redistilled hexane.
5. Eluting mixture - 15% (15 + 85) - purified diethyl ether 150 ml is diluted to 1000 ml with redistilled hexane.
6. Florisil, 60/100 mesh, PR grade, to be stored at 130°C until used.
7. Acetonitrile - reagent grade, saturated with hexane.
8. Anhydrous sodium sulfate - reagent grade, granular, Mallinckrodt stock #8024.

III. Sample Extraction:

1. Weigh sample into a clean dry centrifuge bottle. Sample should be thawed and well vortexed before weighing.
2. Add enough pre-cleaned glass wool to adhere to the coarse precipitate of milk solids.
3. Add 100 ml of redistilled acetone to the centrifuge bottle and shake manually for one minute and then centrifuge for approximately two minutes at 1500 rpm.
4. Transfer the acetone to a 500 ml Separatory funnel.
5. Extract the milk precipitate two more times with equal volumes of 25 ml of acetone each time, shaking, but not centrifuging. All three acetone extractions are combined in the 500 ml Separatory funnel.
6. Add 50 ml of n-hexane to the coarse precipitate of milk solids, shake, decant, and combine with the acetone extracts in the 500 ml Separatory funnel. Repeat. Add 50 ml n-hexane.
7. Add a volume of 125 ml of 2% Sodium Sulfate to the 500 ml Separatory funnel.
8. Shake the Separatory funnel manually for one minute, allow phases to separate and discard the lower aqueous layer.

9. Repeat steps #7 and #8, again discarding the lower aqueous layer.

10. Prepare a column containing 3 inches of sodium sulfate. Wash the Na_2SO_4 with approximately 100 ml of n-hexane; discard, and as the wash hexane reaches the top of the sodium sulfate, drain the n-hexane extract from the 500 ml separatory funnel into the Na_2SO_4 column. Allow this extract to sink into the top of the sodium sulfate and add 100 ml of n-hexane to the column collecting the elute in a clean, dry 250 ml concentrator flask.

11. Reduce the volume in the 250 ml concentrator flask to approximately 10 ml and transfer quantitatively using a clean, disposable pipet to a 100 ml volumetric flask. Bring to volume with n-hexane.

12. Pipet a volume of 20 ml from the 100 ml volumetric flask and pour into a clean, dry 50 ml beaker. This 20 ml represents 1/5 of the original sample size. This 20 ml is then placed into a 37° oven overnight for a lipid determination.

13. The remaining 80 ml volume is reduced and quantitatively transferred to a 125 ml separatory funnel.

IV. Liquid - Liquid Partitioning:

1. Add 30 ml of acetonitrile, previously saturated with hexane. Stopper funnel and shake vigorously for 2 minutes.

2. Allow phases to separate and draw off the acetonitrile layer into a 1-liter separator containing 550 ml of a 2% solution of Na_2SO_4 and 100 ml of hexane.

3. Similarly extract the hexane layer in the 125-ml separator three more times with 30-ml portions of acetonitrile, combining all acetonitrile extracts in the 1-liter separator.

4. Stopper, invert 1-liter separator, vent off pressure and mix by shaking for two minutes, releasing pressure as required.

5. Allow the layers to separate and drain aqueous layer into a second 1-liter separator

6. Add 100 ml hexane to second separator, and after a 30-second vigorous shaking, discard aqueous phase and transfer pet. ether phase into first 1-liter separator.

7. Wash hexane with two 100-ml portions 2% Na_2SO_4 and discard the aqueous washings.

8. Attach a 3-ball Snyder column to the top of the K-D evaporator and place in a 90-100°C water bath. Approximately 1-1/2 inches of the concentrator tube should be below the surface of the water.

9. Concentrate the extract to ca 5 ml, rinse down the sides of K-D evaporator and the ground glass joint with a total of 3 ml pet. ether. Reconcentrate extract to ca 5 ml under a gentle stream of nitrogen at room temperature.

V. Florisil Fractionation:

1. Prepare a chromatographic column containing 4 inches (after settling) of activated Florisil topped with 1 1/2 inch of anhydrous, granular, Na_2SO_4. A small wad of glass wool, preextracted with pet. ether, is placed at the bottom of the column to retain the Florisil.

   NOTE: (1) The amount of Florisil needed for proper elution should be determined for each lot of Florisil.

2. Prewash column with 100 - 200 ml hexane.

   NOTE: (1) From this point and through the elution process, the solvent level should never be allowed to go below the top of the Na_2SO_4 layer. If air is introduced, channeling may occur, making for an inefficient column.

3. Using a 5-ml Mohr or a long disposable pipet, immediately transfer the tissue extract (ca 5 ml) from the evaporator tube onto the column and permit it to percolate through.

4. Rinse tube with two successive 5-ml portions of pet. ether, carefully transferring each portion to the column with the pipet.

   NOTE: (1) Use of the Mohr or disposable pipet to deliver the extract directly onto the column precludes the need to rinse down the sides of the column.

5. Prepare two Kuderna-Danish evaporative assemblies complete with 10 ml graduated evaporative concentrator tubes. Place one glass bead in each concentrator tube.

6. Replace the 500- ml Erlenmeyer flask under each column with a 500-ml Kuderna-Danish assembly and commence elution with 200 ml of 6%. diethyl ether in pet. ether (Fraction I). The eltuion rate should be 5 ml per minute. When the last of the eluting solvent reaches the top of the Na_2SO_4 layer, place a second 500-ml Kuderna-Danish assembly under the column and continue elution with 200 ml of 15% diethyl ether in pet. ether (Fraction II).

7. Remove assemblies from bath, and cool to ambient temperature.

8. Disconnect collection tube from Kuderna-Danish flask and carefully rinse joint with a little hexane.

9. Attach modified micro-Snyder column to collection tubes, place tubes back in water bath and concentrate extracts to 1 ml. If preferred,

this may be done at room temperature under a stream of nitrogen.

10. Remove from bath, and cool to ambient temperature. Disconnect tubes and rinse joints with hexane.

NOTE: (1) The extent of dilution or concentration of the extract at this point is dependent on the pesticide concentration in the substrate being analyzed and the sensitivity and linear range of the Electron Capture Detector being used in the analysis.

Appendix E

DATE: November 7, 1975

SUBJECT: Quality Control, Human Milk

FROM: Colorado Epidemiologic Pesticide Studies Center J. Tessari

TO: Participating Laboratories, National Human Milk Study

On November 7, 1975, we plan to mail a vial containing approximately 3 ml of a spiking solution to be used as an inter-laboratory quality control check for the National Human Milk Study. Analyze this spike as follows:

1. From one human milk sample weigh out two 7 gm aliquots of milk. To one of these add 1 ml of the spiking solution. Extract and analyze both sub-samples following the established procedure for human milk analysis.
2. Use a second 1 ml portion of the spiking solution and make a 1:5 dilution in hexane. Analyze this dilution directly on gas chromatographic columns.

Send calculations and gas chromatograms of the milk samples, both spiked and unspiked, and of the spike dilution, to the Colorado lab, to be received no later than November 21, 1975.

Appendix E

Table E - 1

Human Milk Interlaboratory Check Sample
Summary of Results
National Human Milk Study 1975

Pesticides reported in nanograms

	Oxy-chlordane	t-nona-chlor	Hepta-chlor	Dieldrin	p,p'-DDT	p,p'-DDE	β-BHC
Formulation	40	40	40	40	200	400	0
Laboratory							
1	40.0	36.8	31.0	35.8	213.9	430	0
2	37.1	33.7	-	34.0	166.7	387.2	0
3	36.4	30.1	15.6	-	179.4	393.7	0
4	-	44.2	-	55.8	166.6	764.8*	✓
Mean	37.8	36.2	23.3	41.9	181.6	403.3	
Standard Deviation	1.9	7.3	10.9	12.1	22.3	23.1	
Relative Standard Deviation	5.0%	19.8%	46.7%	28.9%	12.3%	5.7%	
Total Error	14.9	46.1	96.2	65.4	31.5	12.4	

- No value reported

✓ False identification

* Rejected as outlier

Table E - 2

RELATIVE PERFORMANCE RANKINGS OF HUMAN MILK CHECK SAMPLE

Human Milk Study 1975

Laboratory	Compounds Missed	False Identification	[1]Number of Rejections	[2]Total Score
1	0	0	0	196.5
2	1	0	0	161.8
3	1	0	0	160.0
4	2	1	1	97.5

[1] Values outside confidence limits

[2] Total possible score 200 points

Appendix E

NATIONAL HUMAN MILK STUDY

Bottle Number	Date Sample Collected	Patient I.D.	Date Lab Received	Initial Volume	Hospital, Agency, Area	Colo No.	Date Extract	Grams Analyzed	Coulson Conf.	Pool		Additional Information
										6% Grams	15% Grams	
#1	4/12/75	Jane Doe	4/12/75	50 mls.	Larimer Co. Hosp.	1-1 VaB	4/30/75	14.6	X	14.6	14.6	QC-28-1
#50	4/22/75	RS	4/28/75	25 mls.	Charity H. New Orleans	2-2	4/30/75	7.3 5.0-5/6	X	5.0	*4.5	Reextract-5/6
#23	5/3/75	-	5/16/75	35 mls.	Maine	35-4	5/21/75	14.3	X	14.3	14.3	Blind-S.#1

*Dilution made and discarded

Appendix F

Illustrations of the spiking solution, gas chromatograph standards, temperature and flow parameters, and selected chromatograms for standards used in the National Human Milk Study are included in this appendix.

Appendix F

PESTICIDE SPIKING SOLUTION USED IN HUMAN MILK STUDY

	Ng/ml
Dieldrin	40
Oxychlordane	40
Heptachlor	40

Solution made in acetone and 1.0 ml used to spike human milk samples using 10% ration (sample/spike)

Mixture No. 1 (1:100)

Dieldrin	0.1 ml of 1 mg/ml	Dil. up to 10 ml	0.01 mg/ml
Oxychlordane	" "		" "
Heptachlor	" "		" "

Mixture No. 2

Mixture No. 1	@ 2.0 ml	Dil. up to 10 ml	0.002 mg/ml of each

Spiking Solution 0.002 mg/ml $\xrightarrow{1:50}$ 0.0000 mg/ml

Mixture No. 2	1:50	Dieldrin	40 ng/ml
		Oxychlordane	" "
		Heptachlor	" "

Appendix F

GAS CHROMATOGRAPH STANDARDS USED IN HUMAN MILK STUDY

E.C. 1	Pg/µl	
	A	B
α-BHC	4	1
β-BHC	20	5
Aldrin	8	2
Oxychlordane	8	2
Dieldrin	16	4
o,p'-DDT	40	10
p,p'-DDT	40	10
E.C. 2		
Hexachlorobenzene	4	1
Lindane	8	2
Heptachlor	8	2
Aldrin	8	2
Heptachlor Epox.	8	2
p,p'-DDE	20	5
p,p'-DDD	40	10
E.C. 4		
Chlordane	50	
Endrin	10	
E.C. 5		
Aldrin	8	
o,p'-DDE	10	
o,p'-DDD	20	
Mirex	50	

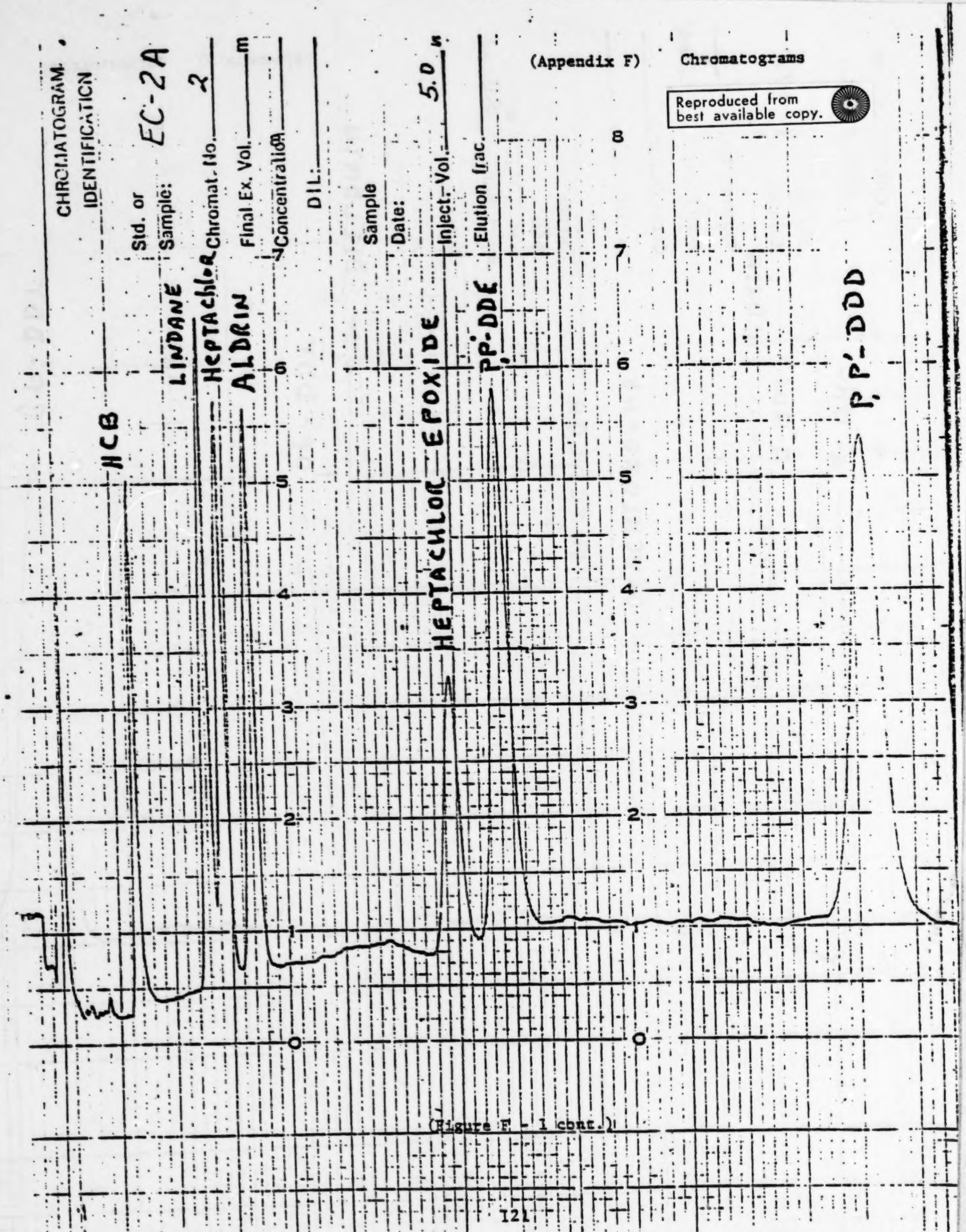
Appendix F

G. C.
TEMPERATURE & FLOW PARAMETERS

DATE: 9/10/75

ELECTRON Capture	**FPD or Coulson**
UNIT NO. 4	
Column Idenity OV 210	
Temp. °c	
Inlet 223 Column 180	Inlet ____ Column ____
Detector 214 Transfer 243	Detector ____ Transfer ____
Flow, Ml/min. 78	
Carrier N₂	Carrier ____ Hydrogen ____
Chart Speed .5 in/min.	Oxygen ____ Air ____
B.G.C. 3-3 Pol. Volts 6	
Attenuation 16 X 10	Chart Speed ____ in/min.

Reproduced from best available copy.



CHROMATOGRAM IDENTIFICATION

Std. or Sample: EC-2A

Chromat. No. 2

Final Ex. Vol. ______ ml

Concentration ______

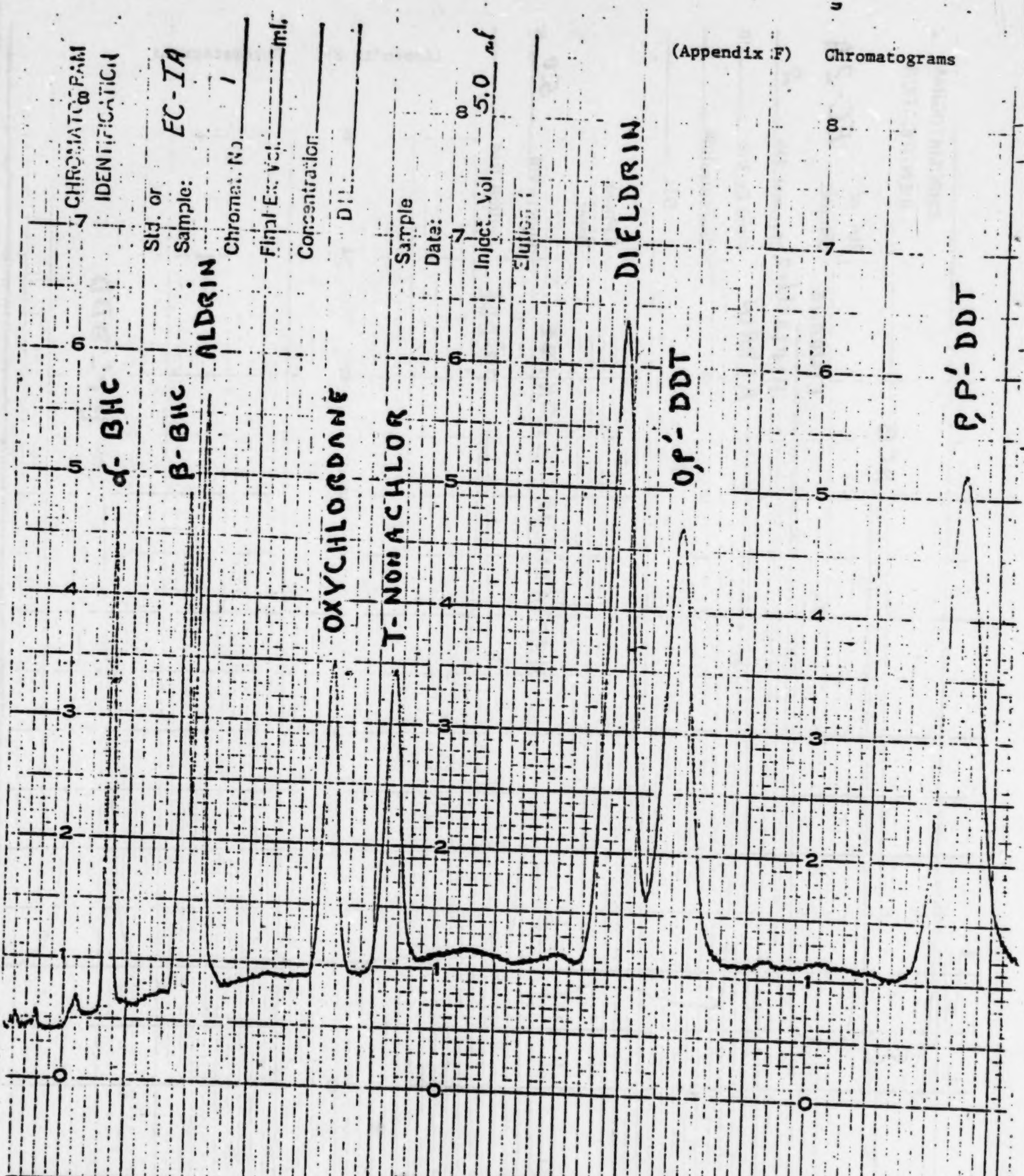
DIL: ______

Sample Date: ______

Inject. Vol. 5.0 µl

Elution frac. ______

(Figure F - 1 cont.)



(Figure F - 1 cont.)

G. C.
TEMPERATURE & FLOW PARAMETERS

DATE: 9/10/75

ELECTRON Capture

UNIT NO. 6

Column Idenity 0.V17

Temp. °C

Inlet 223 Column 195

Detector 210 Transfer 223

Flow, Ml/min. 89

Carrier N₂

Chart Speed 0.5 in/min.

B.G.C. 66 Pol. Volts 13

Attenuation 16 x 10

FPD or Coulson

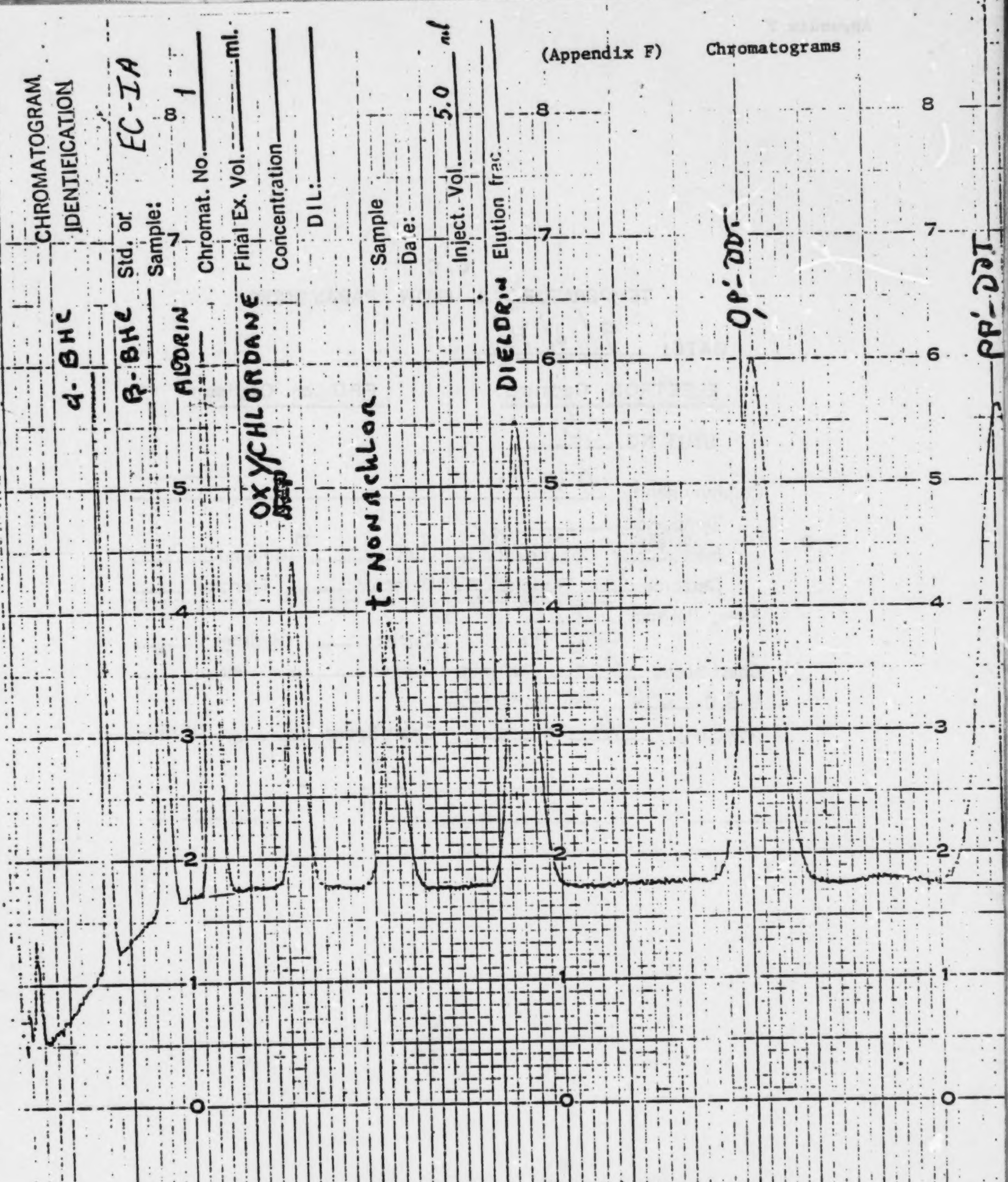
Inlet ______ Column ______

Detector ______ Transfer ______

Carrier ______ Hydrogen ______

Oxygen ______ Air ______

Chart Speed ______ in/min.



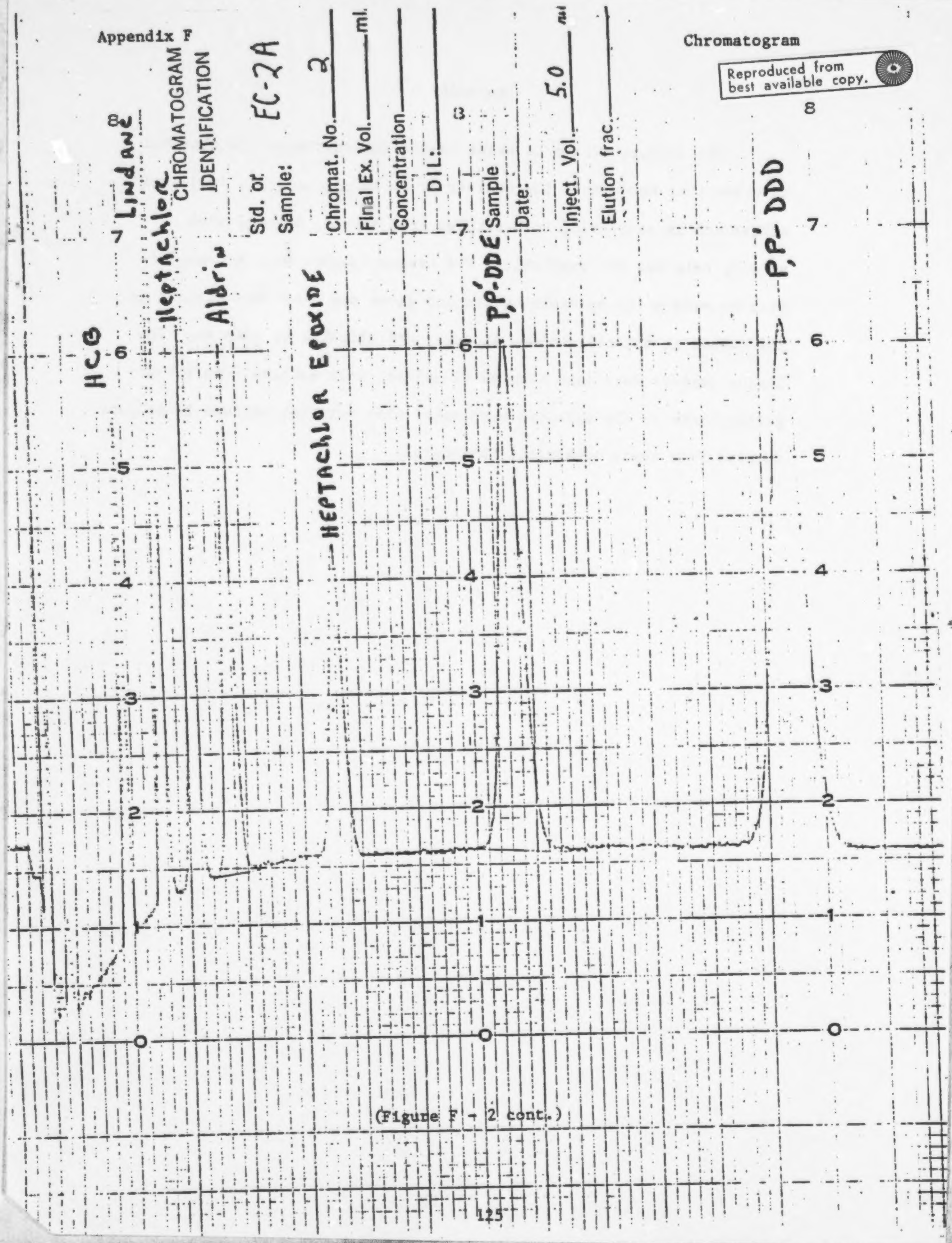
CHROMATOGRAM IDENTIFICATION
Std. of: EC-IA
Sample: 1
Chromat. No.
Final Ex. Vol. ml.
Concentration
DIL:
Sample
Date:
Inject. Vol. 5.0 ml
Elution frac.

(Figure F - 2 cont.)

Appendix F

Chromatogram

Reproduced from best available copy.



(Figure F - 2 cont.)

Appendix G

The support of the La Leche League International was obtained in order that members of the society could be contacted to lend their assistance in retrieving milk samples from nursing mothers when nursing help was not available. The League leaders were acquainted with the study by the epidemiologists and given the same instructions as the nurses in the collection, storage, and shipment of samples. The League leaders were only allowed to collect milk samples from mothers giving birth in the selected hospitals; they were not allowed to collect samples from their membership in general.

Appendix G

Mothering Through Breastfeeding

The World Over

La Leche League International

9616 Minneapolis Avenue Franklin Park, Illinois 60131
Telephone: 312-455-7730

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[illegible] New Zealand
[illegible] AMS, C.M.
[illegible]

May 21, 1975

RECEIVED
MAY 2[illegible] 1975
Community Pesticide Study

Eldon P. Savage, Ph.D., Director
Colorado Epidemiologic Pesticide
Studies Center
Institute of Rural Environmental Health
Spruce Hall, Colorado State University
Fort Collins, Colorado 80521

Re: Study of the levels of chlorinated hydrocarbon insecticides in human milk.

Dear Dr. Savage,

Your study has been cleared by our Research Committee for League participation. A copy of La Leche League International's policy regarding participation in research projects is enclosed.

We will need a list of the states in which you plan to test for the insecticides, so that we may inform the League Area Co-ordinators of those states of the study. Their names will then be sent to you so you may have a League contact in each sampling area. If it is available, a breakdown of the specific towns involved would also be very helpful to us and to the Area Co-ordinators.

Variables which may affect the results of such pesticide studies are listed below for your interest and your information.

1. If the milk sample is a fore or hind one (Kon and Cowie, 1961) it may affect the results as the latter has a higher fat content. However, Wilson et al. (1973) did not find that it made any difference.

2. It has been suggested that if plastic containers are used to collect the milk they should preferably be made of food grade materials in order to avoid the possibility of leaching of plasticizers (Silverman, 1971). Wilson et al. (1973) who used polyethylene bags, tested the milk and again found no difference.

3. Kroger (1972), in his study, found that mothers nursing their first children had higher levels of DDT in their milk. Related to it, Wilson found that the older the mother, the less contaminant was found in her breast milk.

Appendix G

La Leche League is always glad to cooperate in research that relates to human milk. We look forward to hearing from you concerning the additional information we need.

Sincerely,

Edwina Froehlich

Edwina Froehlich

Enc.

EF/ch

REFERENCES

Kon, S.K., and Cowie, A.T. Milk: The Mammary Gland and its Secretion. Vol. II. (New York: Academic Press, 1961).

Kroger, M. "Insecticide Residues in Human Milk." J. Ped. 80:401-405, March 1972.

Silverman, W.A. "Human Milk Banking Practices." Pediatrics 47:456-459, Feb. 1971.

Wilson, D.J., Locker, D.J., Ritzen, C.A., Watson, J.T., and Schaffner, W. "DDT Concentrations in Human Milk." Am. J. Dis. Child. 125:814-817, 1973.

Appendix H

The following questionnaire was used to obtain additional information from the mothers in the quality control portion of the study. Each of the 102 mothers was contacted by telephone and asked the following information.

Appendix H

NATIONAL STUDY TO DETERMINE LEVELS OF CHLORINATED HYDROCARBONS IN HUMAN MILK

PESTICIDE USAGE SURVEY

NAME____________________ ADDRESS____________________ SAMPLE NO.________

COMMUNITY__________________________ HOSPITAL__________________________

TELEPHONE NUMBER______________ AGE_____

Pesticide Usage Questions:

A. Do you or any members of your household use pesticides? Yes ☐ No ☐

B. Are any protective or precautionary measures observed during application of pesticides (i.e., protective clothing, restriction of humans or animals into treated areas)? Yes ☐ No ☐

C. Where are the areas of your pesticide usage?

1. Household
   a. Inside ☐
   b. Yard ☐
   c. Trees ☐
   c. Garden ☐
   e. Pets ☐
2. Farm
   a. Crops ☐
   b. Pasture ☐
   c. Building, pens ☐
   d. Livestock ☐
   e. Fence rows ☐
   f. Seed treating ☐

D. Do you eat vegetables out of your own garden? Yes ☐ No ☐
   1. If yes, how many months out of the year? ____

E. Has a commercial applicator ever treated your premises for pests? Yes ☐ No ☐

F. If so, when, for what reason, and what type of brand of chemical was used?
Date ________________
Chemical______________
Why________________________________

G. What are the trade names of the 3 pesticides most often used by household?
__________________ __________________ __________________

H. Where are all your pesticides stored?
1. Kitchen cabinet ☐
2. Back porch ☐
3. Basement ☐
4. Garage ☐
5. Barn ☐
6. Other ________________

I. Are pesticides stored under lock and key? Yes ☐ No ☐

J. Are the pesticides stored in original containers with warning labels attached? Yes ☐ No ☐

Appendix H

Sample No. ______________

K. Ethnic background:
1. Anglo ☐
2. Negro ☐
3. Oriental ☐
4. American Indian ☐
5. Mexican American ☐
6. Other __________________

L. Have you ever lived near any pesticide plants? Yes ☐ No ☐
1. If yes, what type? ______________________________
____
2. How long have you lived by the pesticide plant? ____________

M. Do you visit with anyone who uses pesticides? Yes ☐ No ☐

N. Smoking Habits
Has never smoked ☐
Smoke now ☐
Cigarettes only ☐
Amount-packs per day
Less than ½ ☐
½ - 1 ☐
1 - 2 ☐
Cigarettes and other ☐
Pipe only, cigars only or pipe and cigars ☐
Used to smoke ☐
Months _____ Years _____

O. Do you use butter or margarine? Butter ☐ Margarine ☐ Both ☐

P. How many children were breast fed? ______
1. How long were they breast fed?

	Days	Weeks	Months	Years
1st				
2nd				
3rd				
4th				
5th				

Mobility (household head)

A. Occupation of household head? ______________________

B. How long has household head held present job?
1. Less than 1 year ☐
2. 1-2 years ☐
3. 3-5 years ☐
4. 6-10 years ☐
5. Over 10 years ☐

C. What did household head do prior to this job? ______________________

Mobility (Mother)

D. Where were you born?
State ____________________
County ____________________

Appendix H   Sample No.__________

E. List all residences for the past 10 years beginning with the present:

1. State______________ County________________
   Months ______________ Years________________
2. State______________ County________________
   Months______________ Years________________
3. State______________ County________________
   Months______________ Years________________
4. State______________ County________________
   Months______________ Years________________
5. State______________ County________________
   Months______________ Years________________
6. State______________ County________________
   Months______________ Years________________

F. Your father's occupation?______________________________

G. Highest grade level attained by mother?__________________

H. Highest grade level attained by mother's father?__________________

* How many errors were made on the original information card?______________

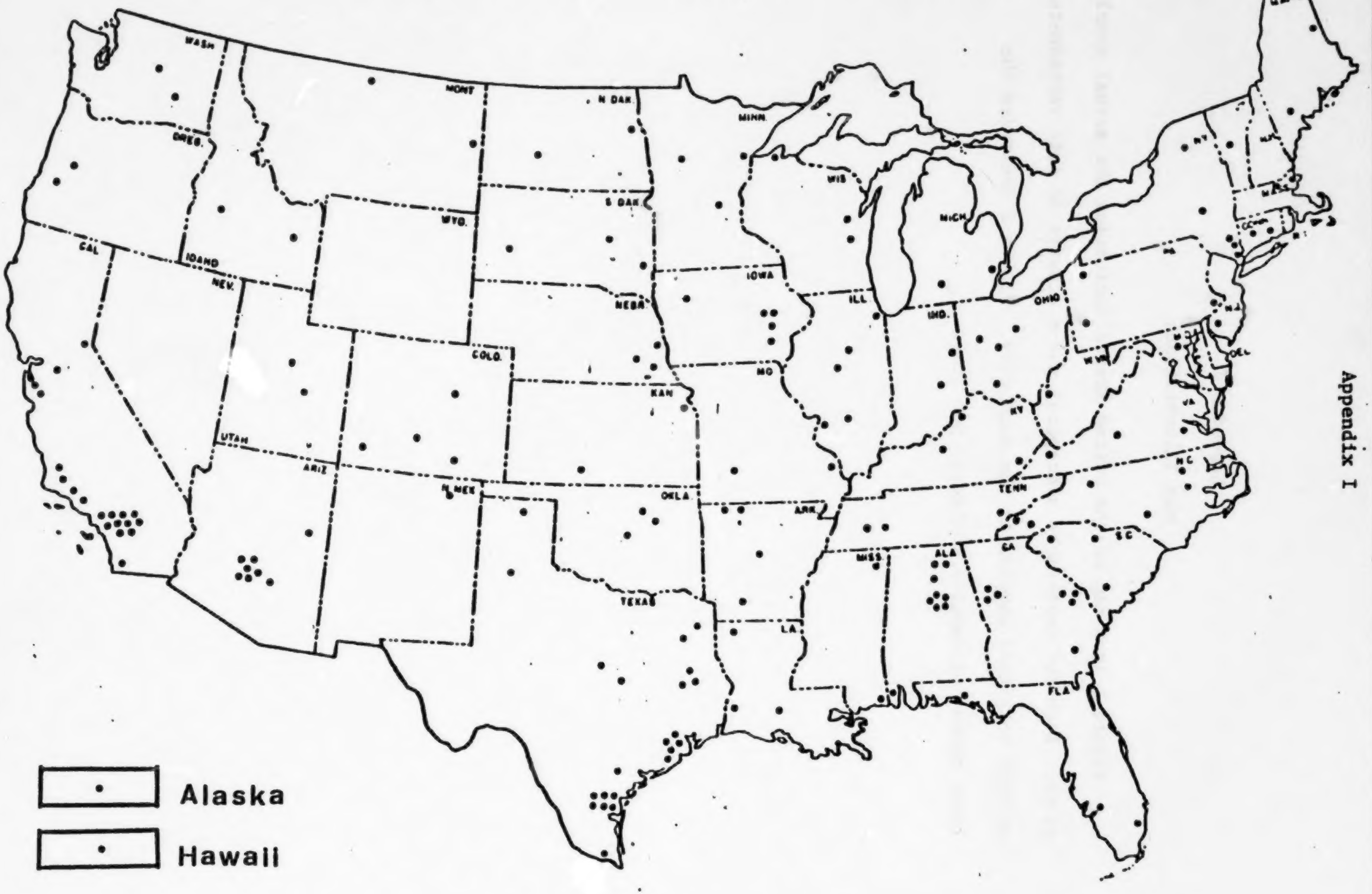
Appendix I

Map Illustiations

Figure 1 is a map of the United States indicating the actual sampling sites. Each dot represents a hospital and a cluster of dots represents several hospitals sampled in the same city. Figure 2 indicates the total number of samples collected per state.

Figure I-1

Sampling Sites for Human Milk Study 1975


WASH
OREG.
CAL
IDAHO
NEV.
MONT
WYO.
UTAH
ARIZ
COLO.
N MEX
N DAK.
S DAK.
NEBR
KAN
OKLA
TEXAS
MINN
IOWA
MO
ARK
LA
WIS
ILL
MICH
IND.
OHIO
KY
TENN
MISS
ALA
GA
FLA
S C
N C
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PA
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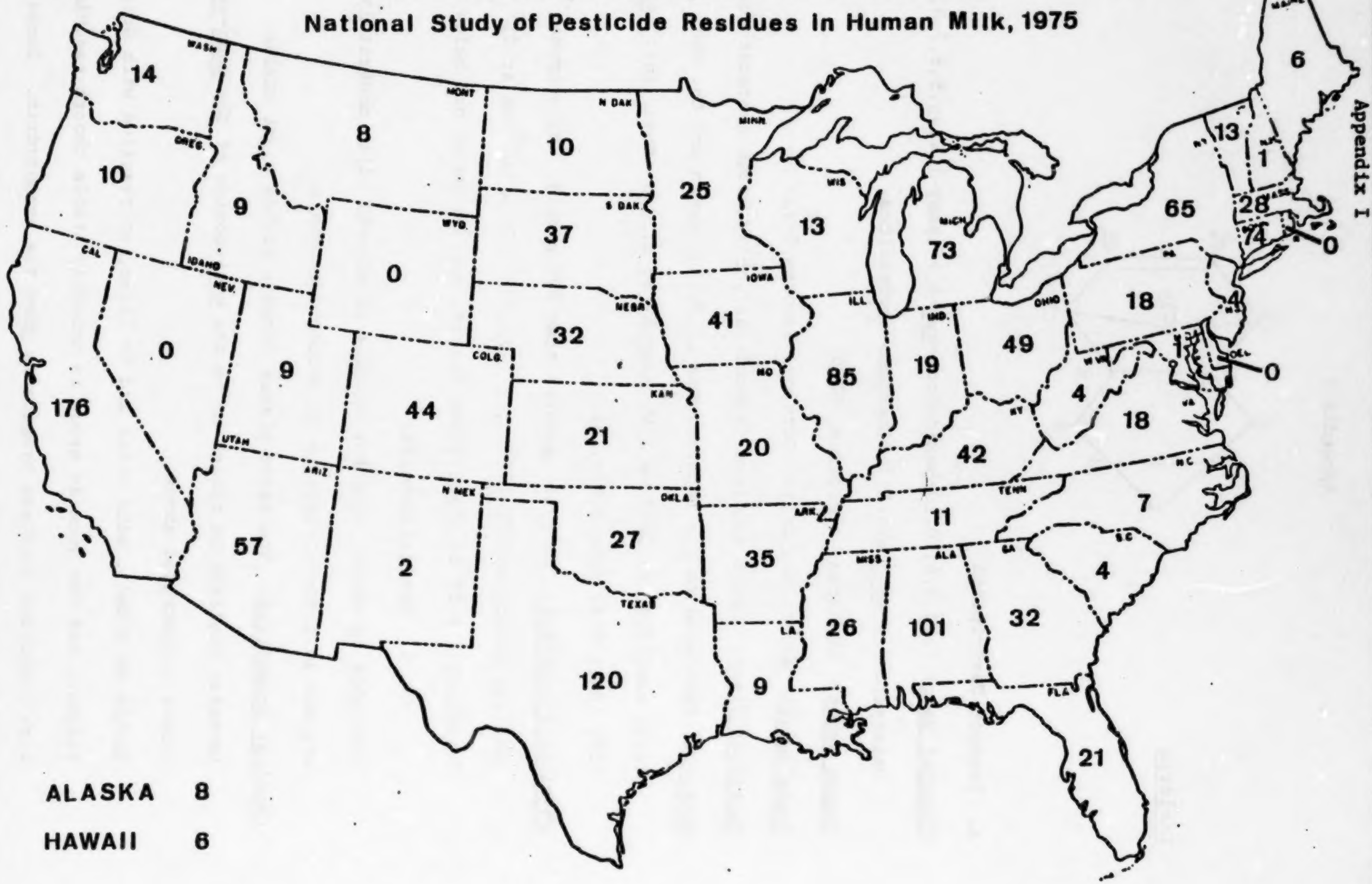
MAINE
N.H.
MASS
CONN
R.I.
N.J.
DEL
Alaska
Hawaii

Figure I-2

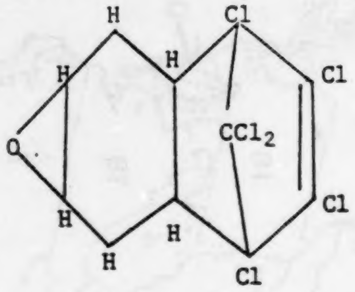


Number of Samples Analyzed from Each State
National Study of Pesticide Residues in Human Milk, 1975

WASH 14
OREG. 10
CAL 176
IDAHO 9
NEV. 0
MONT 8
WYO. 0
UTAH 9
ARIZ 57
COLO. 44
N MEX 2
N DAK 10
S DAK 37
NEBR 32
KAN 21
OKLA 27
TEXAS 120
MINN 25
IOWA 41
MO 20
ARK 35
LA 9
WIS 13
ILL 85
MICH 73
IND. 19
OHIO 49
KY 42
TENN 11
MISS 26
ALA 101
GA 32
FLA 21
S C 4
N C 7
VA 18
W VA 4
PA 18
N Y 65
N J 4
DEL 0
MD 1
VT 13
N H 1
MAINE 6
MASS 28
CONN 74
R I 0
ALASKA 8
HAWAII 6

Appendix J

Dieldrin



A. Product Description

Chemical Name: 1,2,3,4,10,10-hexachloro-exo-6,7-epoxy-1,4,4a,5,6,7,8, a-octahydro-1,4-endo,exo-5,8 dimethano-naphthalene.

Common Names: Dieldrin, dieldrine, HEOD.

Trade Names: Alvit, Dieldrite, Octalox, Penoram D-31.

Pesticide Class: Broad spectrum insecticide; chlorinated hydrocarbons.

History: Developed in the laboratories of Julius Hyman and Co. and first described in 1948 by C.W. Kearns, et al., J. Econ. Ent., 42, 127, 1949; U.S. Pat. 2,676,131.

Physical Properties: Recryst. greater than 99% purity; white cryst. odorless solid, mp 175-176° C; d 1.75; vp 7.78×10^{-7} mm at 25° C.

Technical: buff to light brown flakes, setting point not below 95 C. Non-inflammable.

Insoluble in water; slightly soluble in mineral oils; moderately soluble in acetone; soluble in aromatic solvents.

Chemical Properties: The above planar formula yields eight steric isomers; dieldrin is though to be the exo-epoxide of the endo-exo-isomer illustrated above.

Stable to alkali, mild acids and to light; no reaction with Grignard reagent, and the epoxide group is unusally stable though reacting with anhydrous hydrogen bromide to give the bromohydrin. Compatible with common pesticides.

Biological Properties: Of high contact and stomach toxicity to most insects, highly persistent and effective in the control of many crop pests at rates of the order of 4-8 oz/acre. Non-phototoxic; non-systemic.

Acute mammalian toxicity by ingestion low (LD 50 for rats 100 mg/kg) when compared to high dermal toxicity (Lehman, A.J., Bull. Assoc. Food Drug. Off. U.S., 14, 82, 1950). Princi, F. and Spurbeck, G.H. (Arch. Ind. Hyg. Occupt. Med. 3, 64, 1951) quoted LD 50 in single oral dose to dogs 65-95 mg/kg and reported no observable chronic injury to workers engaged in its manufacture. Dutra, F. (U.S. Food Drug Admin., Residue Tolerance Hearings, Exh. 1215, 1281, Washington, 1950) reported that quantities greater than 50 ppm in the diet of rats produced degenerative changes in the liver, changes not observed with diets containing 25 ppm. Chronic toxicity shown in rabbits to which dieldrin was applied externally over a week in amounts equivalent to 70 mg/kg but no observable effect at 30 mg/kg; toxic symptoms in rabbits fed at 60 mg/kg level. (Bundren, J., et al., Proc. Soc. Exptl. Biol. Med., 79, 236, 1952). Threshhold limit value (Am. Conf. Gov. Ind. Hyg., 1959) 0.25 mg/M3. LD_{50} dieldrin metabolites 1205 mg/kg; Korte, F., et al., Life Sci., 4, 2017, 1965.

B. Manufacture and Formulations

Manufacturer: Shell Chemical Company

Manufacture: By the oxidation of aldrin with peracetic or perbenzoic acid.

Formulation: Emulsifiable concentrate: 2 lb/Imp gal (Canada, 1955); wettable powder 50%; dusts, regular, 2%. With certain carriers addition of urea (to 5% of carrier) recommended, see Handbook of Aldrin, Dieldrin and Endrin Formulation, Shell Chem Corp, Dec., 1954.

C. Use Patterns

General: Dieldrin is a cyclodiene compound in the chlorinated hydrocarbon class insecticides. It is one of the most persistant chemicals ever known. It is a broad spectrum insecticide that can be used as a household and public health insecticide.

Action: Broad-spectrum insecticide; contact and stomach poison that does not provide a quick kill but does offer excellent residual activity. Stimulates central nervous system poison. Exact mode of action is not known.

Target Crops: Apples, apricots, bananas, barley, beans, blueberries, blackeyed peas, broccoli, brussel sprouts, bush and vine fruit, cabbage, carrots, cauliflower, cherries, citrus fruits, corn, cotton, cowpeas, cucumbers, deciduous fruits and nuts, eggplant, grain, horseradish, lettuce, onions, parsnips, peppers, pimentos, potatoes, radishes, sorghun, soybeans, squash (summer), sweet potatoes, tobacco, tomatoes, asparagus, garlic, leeks, shallots.

Target Insects: Soil insects, cotton pests, household and public health insects, thrips, ants, white-fringed beetles, termites, cutworms, crickets, armyworms, grasshoppers, grubs, plant bugs.

Application: Soil treatment (most important), foliar application, seed treatment, indoor residual surface application and spot or band treatment. Soil applications, predominantly broadcast, animal dusts or sprays.

Rate of Application: Soil treatment: .25 lb AI/acre up to 5 lb AI/acre

Seed treatment: 2.0 oz/bu seed.

Foliar application: 3.0 lb AI/acre (spray)

0.75 lb AI/acre (dust)

Indoor applications: 2.0% AI (lacquer)

2.0% AI (in water for spray)

Use on animals: 0.003 lbs/head (dust)

Frequency: Against woil insects on crops: One application per season.

Other uses: one or more treatments per year, as required.

Time of application: Agricultural uses: Mostly spring, at planting time.

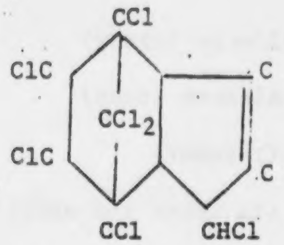
D. Environmental Impact Potential

Mammalian Toxicity: In acute toxicity tests, dieldrin is highly toxic to laboratory animals by the oral, dermal and inhalation routes. It is mildly irritating to the eyes and to the skin.

Nontarget Organisms: Dieldrin is highly toxic to fishes, lower aquatic organisms, birds, wild mammals, and to soil insects. It is relatively nontoxic to other soil organisms. Dieldrin is also highly toxic to bees and beneficial insects (predators and parasites) on direct contact, but this is not a problem in its predominant use as a soil insecticide.

Appendix J

Heptachlor



$C_{10}H_5Cl_7$

Mol. wt. 373.3

A. Product Description

Chemical Name: 1,4,5,6,7,8-Heptachloro-3a,4,7,7a-tetrahydro-4,7,-methanoindane

Common Names: heptachlor, heptachlore (France)

Trade Names: Drinox H-34, Heptamul

Pesticide Class: Insecticide; chlorinated hydrocarbon.

History: First isolated from technical chlordane.

Physical Properties: Pure: white crystalline solid with mild camphor odor; mp 95-96°C.

The technical product contains about 72% heptachlor and 28% of related compounds; a soft waxy solid, melting range 46-74°C; d^9 1.57-1.59; viscosity 50-75 centipoises at 90°C. Vapor pressure (estimated) 0.0004 mm Hg at 25°C. Practically insoluble in water, soluble in ethyl alcohol (4.5 g/100 ml) and in kerosene (18.9 g/100 ml).

Chemical Properties: Stable to light, moisture, air and to moderate heat. Not readily dehydrochlorinated (Rogoff, W.M. and Metcalf, R.L., J. Econ. Ent. 44: 910, 1951.). Compatible with most commonly-used pesticides and fertilizers. Susceptible to epoxidation.

Biological Properties: Strong insecticidal properties by injection or contact; some fumigant action (Rogoff and Metcalf., loc. cit.). Acute oral LD50 to rats, 130-135 mg/Kg; chronic toxicity probably somewhat higher than chlordane; rabbits subjected to 6 hours a day contact with 500 mg died after seven such periods, but no effect after 53 such exposures to 100 mg. Skin treatment of rats daily for 12 days with 10 mg. heptachlor in xylene/kg caused toxic symptoms after 12 days; similar treatment with 40 mg/kg chlordane gave toxic symptoms after 28 applications. Acute oral LD_{50} for male rats 100 mg/kg, for female rats 162 mg/kg; acute dermal LD_{50} for male rats 195 mg/kg, for female rats 250 mg/kg.

Epoxidation which appears to be an important biological reaction, c.f., aldrin and dieldrin, was first observed in dogs and rats by Davidow, B. and Radomski, J.L., J. Pharmacol. Exptl. Therap. 107:259-266, 1953.

B. Manufacture and Formulations

Manufacturer: Veliscol Chemical Corporation, Marshall, Illinois.

Manufacture: (a) By the action of sulphuryl chloride on chlordane in the presence of benzoyl peroxide (Brit. Pat. 618,432). (b) By the chlorination of chlordane in the presence of fuller's earth in the dark (U.S. Pat. 2,576,666).

Formulations: 25% wettable powders; emulsifiable concentrate (usually 2 lb. per gallon); 25% dusts; oil solutions; granules.

Under certain conditions formulation on active clays may lead to slow decomposition with loss of insecticidal activity, a reaction prevented by the addition of a deactivator. (Mahira, M. A. et al., J. Agr. Food Chem. 4:1038, 1957).

C. Use Patterns

General: Heptachlor is used extensively against soil and plant insects. It is one of the more toxic of the chlorinated hydrocarbon group, and, like the others of the group, is absorbed from all body surfaces. It is effective against wireworms, root worms, white grubs as well as turf insects and termites.

Action: Broad-spectrum insecticide; contact, inhalation, and stomach poison. Stimulates the central nervous system. Exact mode of action not known. No systemic action on plants.

Target crops: Barley, beans, cabbage, corn, lettuce, oats, peppers, raspberry, rutabagas, rye, sorghum, tomatoes, wheat, lawns and turf.

Target pests: White grubs, cutworms, wireworms, Japanese beetle larvae, other beetle larvae, other soil insects; termites; grasshoppers; ants.

Application: Soil treatment (most important); seed treatment; bait application (minor). Soil applications by ground equipment, predominantly broadcast.

Rate of Application: Soil treatment: 2.0-5.0 lbs. AI/acre. May be as low as 0.25 lbs. AI/acre for treatment of cabbage.
Seed treatment: 2.0 oz. AI/bushel of seed.
Bait: 4 oz. AI/50 lbs. of bran/acre.

Frequency: Against soil insects on crops: one application per season.
Seed treatment: one treatment per year.

Time of Application: Agricultural uses: mostly spring at planting time. Use against termites, lawn, garden insects during warmer months of the year.

D. Alternatives

On: Barley: chlordane, disulfoton, trichlorfon, methoxychlor
Beans: chlordane, ethion, methoxychlor
Cabbage: chlordane, disulfoton, trichlorfon, Dyfonate, methoxychlor
Corn: chlordane, disulfoton, trichlorfon, Dyfonate, methoxychlor
Lettuce: chlordane, disulfoton, trichlorfon, methoxychlor

Oats: chlordane, disulfoton, trichlorfon, methoxychlor
Peppers: carbofuran, chlordane, trichlorfon, ethion, methoxychlor
Raspberries: chlordane, disulfoton, methoxychlor
Rutabagas: chlordane, methoxychlor
Rye: chlordane, methoxychlor
Sorghum: chlordane, disulfoton, ethion, methoxychlor, carbofuran
Tomatoes: chlordane, disulfoton, trichlorfon, ethion, methoxychlor
Wheat: chlordane, disulfoton, trichlorfon, methoxychlor
Tomatoes: chlordane

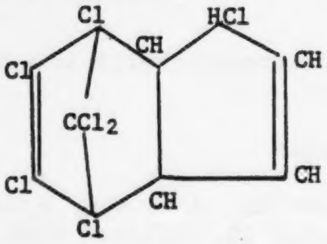
E. Environmental Impact Potential

Mammalian Toxicity: Heptachlor is moderately toxic to laboratory animals in acute toxicity tests via the oral, dermal and inhalation routes. It is moderately irritating to the skin and the respiratory tract. Emulsifiable concentration formulations of heptachlor require the signal word "Warning" on the label. Prolonged exposure to subacute concentrations of heptachlor may produce increasingly severe toxic effects.

Nontarget Organisms: Heptachlor is highly toxic to fishes and lower aquatic organisms. It is highly toxic to birds, moderately toxic to wild mammals, highly toxic to soil insects, and moderately toxic to some soil bacteria and to earthworms. Heptachlor is highly toxic to bees and to beneficial insects (parasites and predators) on direct contact, but this does not take place in its predominant uses where it is applied to the soil.

Heptachlor Epoxide

Heptachlor epoxide, 1,4,5,6,7,8,8-heptachloro-2,3-epoxy-2,3,3a,4,7,-7a-hexahydro-4,7-methanoindene,



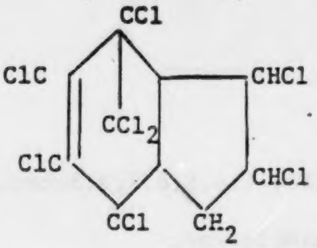
is an oxidation product of heptachlor. Heptachlor epoxide is found on foliage and in soil where heptachlor has been applied and it is also found in fatty tissues of animals that were initially exposed to heptachlor.

Heptachlor epoxide is much more toxic than the parent compound. A single oral dose as little as 2.5 mg/kg has produced poisoning in young dairy calves. Daily doses for 15 days of 1 mg/kg also produced poisoning in calves (4).

Because heptachlor epoxide is a product of heptachlor, symptoms are the same. It is a central nervous system stimulant. Symptoms of acute heptachlor poisoning in man are tremors, ataxia, convulsions, and in severe poisonings renal damage, respiratory failure and sometimes death. In animals symptoms begin with hypertension, disorientation, convulsions, comas. and sometimes death. Because the exact mechanism for poisoning is not known, treatment with specific antidotes is not available. Instead the poisonings are treated with narcotics or anesthetic agents such as chloral hydrate or the barbiturates, phenobarbital and pentobarbital.

Appendix J

Chlordane



$C_{10}H_6Cl_8$

Mol. wt. 409.8

A. Product Description

Chemical Name: 1,2,4,5,6,7,8,8-Octachloro-2,3,3a,4,7,7a-hexahydro-4,7-methanoindane

Common Names: Chlordane, chlordan

Trade Names: Aspon, Belt, Chlor Kil, Corodane, Kypchlor, Octachlor, Ortho-Klor, Synklor, Topiclor 20, Veliscol 1068.

Pesticide Class: Broad spectrum insecticide; chlorinated hydrocarbon.

History: Use as insecticide first described by Kearns, C.W. et al., J. Econ. Ent., 38:661, 1945; Brit. Pat. 618,432.

Physical Properties: Technical: viscous amber-colored liquid; d^{25} 1.59-1.63; n^{25} 1.56-1.57; viscosity 75-120 centistokes at 130°F; insoluble in water; soluble in most organic solvents, including petroleum hydrocarbons. Refined product has vapor pressure 1×10^{-5} mm Hg at 25°C.

Chemical Properties: The chromatographic examination of technical chlordane by March, R.B. (J. Econ. Ent., 45:452, 1952) yielded heptachlor, chlordane, and two isomeric chlordanes; one of mp 104.5-106°C which, being readily dehydrochlorinated by alkali, is thought to be the cis-isomer; the other, of mp 106.5-108°C resistant to dehydrochlorination is thought to be the trans-isomer.

Technical chlordane consists of 60-75% of α- and β-chlordanes with 25-40% of related compounds. The commercial product known as γ-chlordane appears to be substantially the earlier α-chlordane. Technical chlordane consists of 60-75% of isomers of chlordane and 25-40% related compounds including two isomers of heptachlor and one each of enneachlor- and decachloro-dicyclopentadiene. Riemschneider, R., Wld. Rev. Pest Control, 2:29, 1963.

Biological Properties: A persistent stomach and contact poison to most species of insects; more volatile than DDT but shows marked residual toxicity (Hamman, R.E., J. Econ. Ent., 41:516, 1948). Non-systemic and non-phytotoxic at insecticidal concentrations. Relative insecticidal activity to houseflies given by Cristol, S.J. (Adv. Chem. Sec. 1, p. 184, 1950). Other comparative toxicities are cited by Metcalf, R.L., Organic Insecticides, p. 234, 1955.

Of low acute toxicity to mammals: oral LD50 to rats 457-590 mg/Kg; the high vapor toxicity to mice reported by Fringe, H. and O'Tousa, J.E. (Science, 111:658, 1950) attributed by Ingle, L. (Science, 118:213, 1953) to presence of unreacted hexochlorocyclopentadiene, reduced

in insignificant amounts in later material. Rats fed for 104 weeks on diet containing 150 ppm. γ-chlordane suffered no higher mortality than controls but histopathological changes in liver apparent. Threshold limit (Am. Conf. Gov. Ind. Hyg., 1959): 2 mg/M^3.

B. Manufacture and Formulations

Manufacturer: Velsicol Chemical Corporation. Marshall, Illinois.

Manufacture: Hexachlorocyclopentadiene by chlorination of pentanes, (U.S. Pat. 2,509,160), or by action of sodium hydrochlorite on cyclopentadiene, (U.S. Pat. 2,606,910) is condensed into cyclopentadiene to product $C_{10}H_6Cl_{16}$ (chlordene) which is further chlorinated.

Formulations: In kerosene sol. 2% and 20%; emulsifiable concentrate 50% and 70% by wt.: 2,4, or 8 lb/gal.; 5, 6, and 10% dusts; 33 1/3, 25, 20, 10, and 5% granules; 25 and 40% wettable powders.

C. Use Patterns

General: Technical chlordane consists of a heavily chlorinated mixture of isomers. It was the first cyclodiene chemical to be developed for insect control and has been in commercial use for more than 20 years. It is a versatile, broad-spectrum insecticide. Its use volume recently experienced a renewed increase. It is claimed that chlordane residues are somewhat less persistent in the environment than those of, for instance, DDT, aldrin or dieldrin.

Nonagricultural uses accounted for an estimated 80% of total U.S. consumption of chlordane in 1972.

Action: Broad-spectrum insecticide; contact, inhalation and stomach poison. Stimulates the central nervous system. Exact mode of action is not known. No systemic action on plants.

Target Crops: Corn, apples, apricots, cherries, peaches, pears, plums, barley, flax, oats, rye, sorghum, sugar beets, wheat, lettuce, onions, peas, peppers, potatoes, pumpkins, radishes, raspberries, strawberries, tomatoes, turnips, asparagus, beans, beets, broccoli, cabbage, cantaloupe, cauliflower, celery, cucumbers, spinach, squash, sweet potatoes, ornamentals, shade trees, livestock.

Target Insects: White grubs, cutworms, wireworms, Japanese beetle larvae, other beetle larvae, other soil insects; termites; grasshoppers; ants; some foliar insects; household insects; stored products insects, livestock insects. Resistance of target insects in some areas.

Application: Soil treatment (most important); some foliar applications; baits; seed treatment (small); indoor spray applications. Soil applications by ground equipment, predominantly broadcast. Livestock dips or sprays.

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Rate of Application: Soil treatment: 2-5 lb AI/acre, up to 10 lb. AI/acre for some uses.

Seed Treatment: 2 oz. AI/bushel seed.
Foliar Treatment: 1-3 lb AI/acre or 1 lb.AI/100 gal.
Termite Control: 1% AI in water or oil.
Bait: 1 lb AI/acre.
Indoor Applications: 2-3% AI sprays, 5-6% AI dusts.
Use on animals: 2-4 lb AI/100 gal.

Frequency: Against soil insects on crops: One application per season. Other uses: one or more treatments per year, as required.

Time of Application: Agricultural uses: Mostly spring at planting time. Use against termites, lawn, garden and household insects during warmer months of the year. Against animal insects: throughout the year as required.

D. Alternatives**

On: Apples: ethion, methoxychlor
Apricots: ethion, methoxychlor
Asparagus: Dyfonate, methoxychlor
Barley: disulfoton, trichlorfon, heptachlor, methoxychlor
Beans: ethion, methoxychlor
Beets: Dyfonate, trichlorfon, methoxychlor
Broccoli: disulfoton, Dyfonate, methoxychlor
Cabbage: disulfoton, trichlorfon, Dyfonate, heptachlor, methoxychlor
Cantaloupes: methoxychlor
Carrots: disulfoton, trichlorfon, methoxychlor
Cauliflower: disulfoton, trichlorfon, Dyfonate, methoxychlor
*Celery: none
Cherries: ethion, methoxychlor
Corn: disulfoton, trichlorfon, Dyfonate, heptachlor, methoxychlor
Corn (pop & sweet): Dasanit
Cucumbers: ethion, methoxychlor
*Cucurbits: none
Flax: trichlorfon
*Leeks: none
Lettuce: disulfoton, trichlorfon, heptachlor, methoxychlor
Melons: ethion, methoxychlor
Oats: disulfoton, trichlorfon, heptachlor, methoxychlor
Onions: disulfoton, ethion
Onions (dry bulb): Dasanit, ethion, Dyfonate
*Parsnips: None
Peaches: disulfoton, ethion, methoxychlor
Peas: disulfoton, ethion, methoxychlor
Peppers: carbofuran, trichlorfon, ethion, heptachlor, methoxychlor
Plums: ethion, methoxychlor
Potatoes: disulfoton, Dasanit, Dyfonate, methoxychlor, carbofuran
Pumpkins: trichlorfon, methoxychlor
Radishes: Dyfonate, methoxychlor

Raspberries: disulfoton, heptachlor, methoxychlor
Rutabagas: heptachlor, methoxychlor
Rye: heptachlor, methoxychlor
*Shallots: none
Sorghum: disulfoton, ethion, heptachlor, methoxychlor, carbofuran
Spinach: disulfoton, methoxychlor
Squash: ethion, methoxychlor
Strawberries: disulfoton, ethion, Dyfonate, methoxychlor
Sugar Beets: disulfoton, Dasanit, trichlorfon, Dyfonate, carbofuran
Sweetpotatoes: Dasanit, Dyfonate, methoxychlor
*Swiss chard: none
Tomatoes: disulfoton, trichlorfon, ethion, heptachlor, methoxychlor
Turnips: disulfoton, methoxychlor
Wheat: disulfoton, trichlorfon, heptachlor, methoxychlor
Barns: trichlorfon
Pens (animal): trichlorfon, methoxychlor
*Storage Bins, Sacks, Crates, etc.: none

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*Indicates crop or other target areas that have no registered substitute for chlordane included in the list of 11 possible substitute chemicals.

**Only those 13 chemicals under study are reported as possible substitutes.

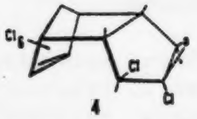
E. Environmental Impact Potential

Mammalian Toxicity: Chlordane is moderately toxic to laboratory animals in acute toxicity tests via the oral, dermal and inhalation routes. It is moderately irritating to the eyes, and slightly irritating to the skin and the respiratory tract. Emulsifiable concentrate formulations of chlordane require the signal word "Warning" on the label, granular and dust of lower concentration require the signal word "Caution." Prolonged exposure to sub-acute concentrations of chlordane may produce increasingly severe toxic effects.

Nontarget Organisms: Chlordane is highly toxic to fishes and lower aquatic organisms. It is slightly toxic to birds, moderately toxic to wild mammals, highly toxic to soil insects, and moderately toxic to some soil bacteria and to earthworms. Chlordane is highly toxic to bees and to beneficial insects (parasites and predators) on direct contact, but this does not take place in its predominant uses where it is applied to the soil or indoors.

Oxychlordane

Oxychlordane, 1-exo, 2-endo, 4,5,6,7,8,8-octachloro-2,3-exo-epoxy-2,3,3a,4,7,7a-hexahydro-4,7-methanoendene,



is a metabolite that accumulates in the tissue of animals that have been exposed to technical chlordane. It is formed from both of the principle octachloro isomers (cis, trans) of technical chlordane.

In a study conducted by Street and Blau, oxychlordane accumulation in rat adipose tissue was shown to exceed that of the parent chlordane isomers for both sexes. They, therefore, concluded that oxychlordane is a major terminal chlordane residue in rats and other mammalian species (1).

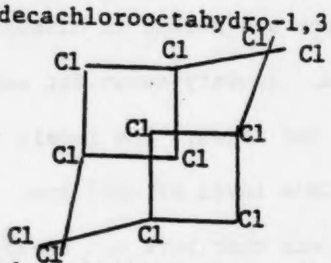
Because of the structural similarities between oxychlordane and the other chlorinated cyclodiene epoxides, it was thought the metabolite would be more toxic. Street and Blare found that this was not true (1).

A study done by Dorough and Hemken showed that cows fed diets containing high purity chlordane were positive for oxychlordane in their milk fat when analyzed (2).

Oxychlordane residues were also found in human adipose tissue by Biros and Enos (3). Of the 27 human adipose tissues sampled, 77.8% contained oxychlordane with levels that ranged from 0.03 to 0.4 ppm and averaged 0.14 ppm.

Mirex

Mirex, Dodecachlorooctahydro-1,3,3-methano-2H-cyclobuta [cd] pentalene,



is a chlorinated cyclodiene compound. It is a white crystalline, nonvolitile and odorless solid with a melting point of 485° C. It is practically insoluble in water and is partially soluble in dioxane, xylene, and benzene.

Mirex is a stomach insecticide used in the control of the imported fire ant in the southeastern part of the United States. In 1961, Allied Chemical Company monitored for Mirex in whole milk and milk fat in a small herd of cattle grazing on pastures treated with Mirex. It was found that the whole milk contained .002 to .007 ppm, and .03 to .13 ppm of Mirex was found in the milk fat (5, 6). This data is in doubt though because these same levels were found in pretreatment samples and in untreated check animal's milk.

Because of the ability of cows to readily concentrate other chlorinated hydrocarbons in their milk, the inability to monitor for Mirex in milk has been the concern of four researchers (7). Samples of cow's milk were collected from various dairy farms and processing plants in areas where the cattle grazed on pastures which had received two or more treatments of Mirex bait. A total of 66 were collected and analyzed out of 5 southeastern states. Six milk samples were from untreated areas and were used as controls. None of the 60 samples analyzed had Mirex residues at the level of detection, 0.3 ppb. There were some that had questionable peaks at the retention time for Mirex but none of these could be confirmed.

Appendix J

Mirex levels can, however, be detected in the fat from beef cattle. A study was done by Ford, Hawthorne and Markin in Mississippi and Georgia in 1971 to determine these levels. Seventy-seven fat samples were analyzed and 67 of them came out positive for Mirex. The levels ranged from .001 to .125 ppm, with an average residue level of .025 ppm. As a control, 69 fat samples were analyzed from areas that were not treated with Mirex. Mirex residues were not found in these samples (8).

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SUPPLEMENTARY REPORT TO THE NATIONAL STUDY TO DETERMINE LEVELS OF CHLORINATED HYDROCARDON INSECTICIDES IN HUMAN MILK

1975-1976

TITLE OF STUDY: Supplementary Report to the National Study to Determine Levels of Chlorinated Hydrocarbon Insecticides in Human Milk

CONTRACT NUMBER: 68-01-3190

DATE SUBMITTED: July 1977

PRIMARY CONTRACTOR: Colorado State University

PROJECT DIRECTOR: Dr. Eldon P. Savage

PRINCIPAL INVESTIGATOR: Dr. Eldon P. Savage

Credit Line and Disclaimer

Conclusions are subject to change on the basis of additional information and evidence. Information contained herein is not to be reprinted or published without written permission of the Environmental Protection Agency. The views expressed herein are those of the investigators and do not necessarily reflect the official viewpoint of the Environmental Protection Agency. These investigations were supported through a contract with the Epidemiologic Studies Program, Human Effects Monitoring Branch, Technical Services Division of the Environmental Protection Agency, Washington, D.C. 20460.

PREFACE

This study was conducted by the Epidemiologic Pesticide Studies Center of Colorado State University in cooperation with the Medical University of South Carolina, Mississippi State University, Michigan State Department of Health, and Utah State Department of Health; under contract number 68-01-3190, with the Epidemiologic Studies Programs, Office of Pesticides Programs, Technical Service Division, and the Environmental Protection Agency. The project staff included the following personnel:

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Supplementary Report to the National Human Milk Study

1975-1976

Objective

The objective of this study was to estimate the distribution of selected organochlorine pesticide levels in human milk among nursing mothers giving birth in general care hospitals in the United States. The compounds reported in this study include p,p'-DDT, o,p-DDT, p,p'-DDE, α-BHC, β-BHC, γ-BHC, HCB, and TNC.

Since the milk used in this study was originally collected and analyzed for the National Study to Determine Levels of Chlorinated Hydrocarbon Insecticides in Human Milk, that report should be referred to for detailed information on the plan of study, the field epidemiology, sample analysis, and quality control.

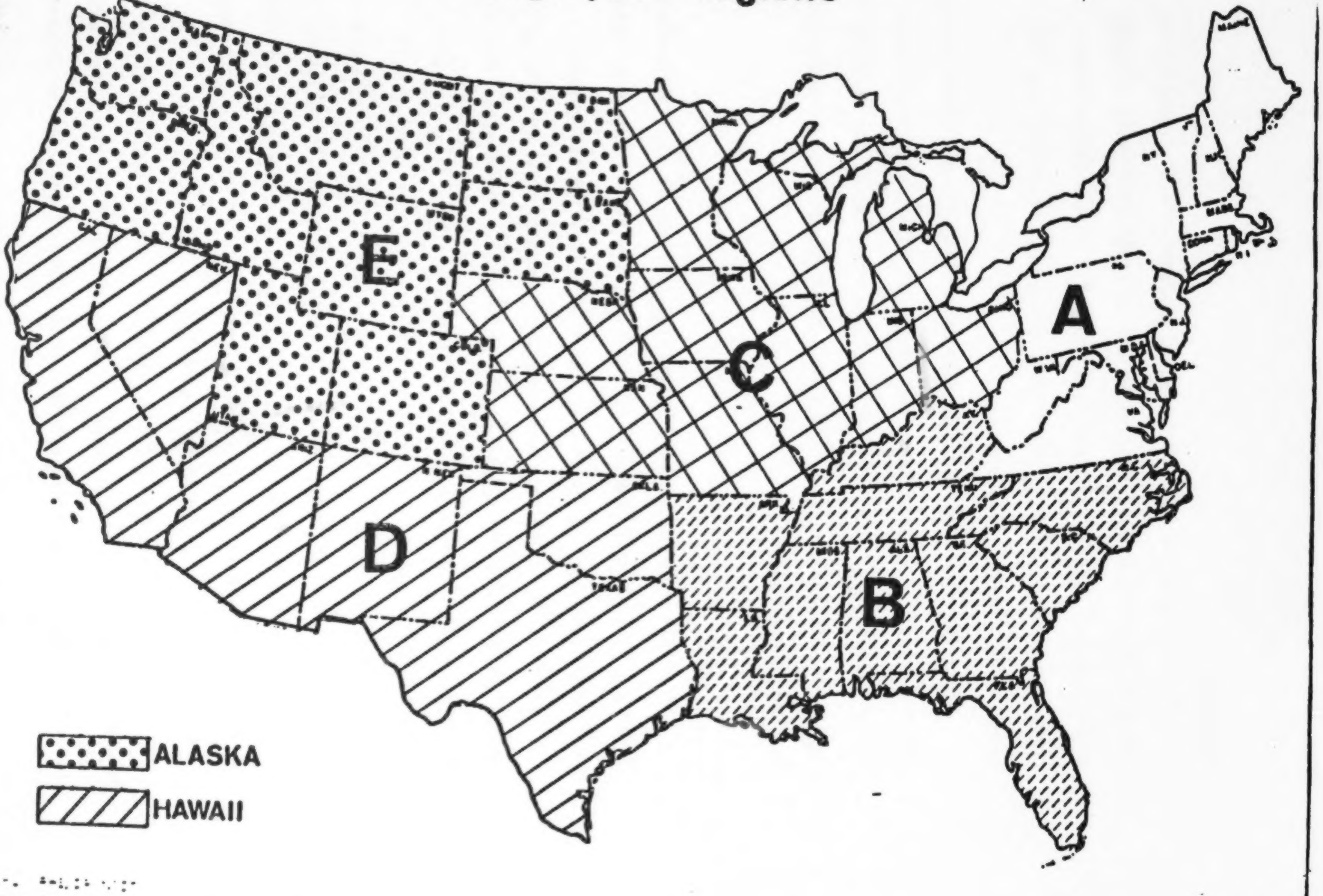
Plan of Study

Hospitals were the primary sampling unit since it was impossible to develop a continuously updated list of nursing mothers. The population sampled consisted of approximately 783 hospitals which had nursery facilities. These hospitals were randomly selected from the list of approximately 7,000 general hospitals according to the protocol for "The National Study of Hospital Admitted Pesticide Poisonings" (7). Each general hospital was classified according to pesticide usage levels (geographic area), state, and geographic region. Hospitals were then selected from each of these strata and ranked according to the number of births per year. The samples were then allocated on the number of births in 1973 proportionally to each chosen hospital. The states within each geographic area are depicted in Figure 1.

After a hospital was selected, the administrator and/or chief of staff was contacted and the number of women to be included in the study was discussed. If the field epidemiologist did not collect the samples,

Figure 1.

Geographic Regions


A
B
C
D
E
ALASKA
HAWAII

a hospital nurse or La Leche League leader was recruited and trained to follow up on sample collection and subsequent shipment of the samples to the laboratory for analysis.

The field epidemiologist nurse, or La Leche League leader selected the nursing mother, instructed her in the procedure to be followed for milk collection, and completed the data information card. The data card included name-age-occupation-race of each study participant, number of siblings, occupation, and highest school year completed by household head. In addition, information was collected to determine if anyone living in the household was employed by a pesticide related industry.

In case a hospital administrator refused to cooperate, an effort was made to contact several local doctors to obtain names of nursing mothers who had recently delivered in the selected hospitals. Another approach was to contact the La Leche League to determine nursing women who had delivered in the target hospital.

Once the required number of nursing mothers was obtained, the hospital was assumed contacted. If local doctors did not cooperate, a La Leche League was not present in the area, or members of the League did not use the target hospital for delivery, a substitute hospital (or hospitals) was selected. Substitutions also were made when the number of mothers nursing was too small, thereby requiring a prohibitive period of time to obtain the required sample size.

Quality Control of Field Epidemiology

The quality control of the study was initiated by two training courses; one for the field epidemiologists and one for the participating chemists.

To evaluate the quality of the field work performed by the field contact person, 10 percent of the participants were rechecked by telephone.

Rechecking served to monitor the thoroughness of the field staff in obtaining pertinent data from the study participants. The verification of data was extremely important since the hospital nurses or La Leche League leaders who participated in the study had received on-site training provided by the field epidemiologist.

Sample Analysis

Milk samples were manually expressed by participants into small glass bottles equipped with plastic screw caps and teflon liners. The filled bottles were kept frozen until time of extraction.

Analytical standards for the chlorinated pesticides were obtained from the pesticide repository of the United States Environmental Protection Agency Laboratory, Research Triangle Park, North Carolina. Solvents were redistilled in glass prior to use. The evaluation, storage, activation, and use of Florisil followed the recommended procedures described in the "Manual of Analytical Methods" (8).

The extraction procedure used was a modification of those described by Guiffrida *et al*. (9) and Curley and Kimbrough (10). The procedure consists of three parts: 1) isolating the fat from the milk, 2) extracting the chlorinated hydrocarbons from the fat, and 3) cleaning up the extract. Calculations were also made to determine lipid content of the milk samples. The specific details of the analytical methods are provided in the original report (6).

The sensitivity limits for the Human Milk Study were: p,p'-DDT, 1 ppb; o,p-DDT, 1 ppb; p,p'-DDE, 1 ppb; α-BHC, 1 ppb; β-BHC, 1 ppb; γ-BHC, 1 ppb; HCB, 1 ppb; and TNC, 1 ppb.

This report is the second of two reports on estimating the distribution of selected organochlorine pesticide levels in human milk among nursing mothers giving birth in general care hospitals in the United States. Organochlorine compounds included in the first study were chlordane, dieldrin, heptachlor epoxide, Mirex, and oxychlordane. This report includes p,p'-DDT, o,p-DDT, p,p'-DDE, α-BHC, β-BHC, γ-BHC, HCB and TNC. Since the detailed methodology, project plan, field epidemiology, and quality control were included in the first report, these details will not be repeated in this report.

Results:

Results of analysis of p,p-DDT, o,p-DDT, p,p'-DDE, α-BHC, β-BHC, γ-BHC, HCB and TNC are reported in this study. A total of 1436 samples were collected and analyzed nationwide.

The composition of the sample of mothers by region and age, race and occupation is given in Tables 1,2, and 3 respectively. The percentages given represent the proportion of mothers in a region in a given classification. For example, of the 233 mothers sampled in Region A (northeast), 40 or 17.2 percent were between 20-24 years old, 5 or 2.1 percent were black and 146 or 62.7 percent were housewives.

Table 1. THE NUMBER AND PERCENT OF STUDY PARTICIPANTS BY U.S. REGION AND AGE

Human Milk Study 1975

Region	Age						Total
	Un-coded	15-19	20-24	25-29	30-34	35+	
A (NE)							
N	1	6	40	103	61	22	233
%	0.4	2.6	17.2	44.2	26.2	9.4	100.0
B (SE)							
N	1	20	85	120	49	13	288
%	0.3	7.0	29.5	41.7	17.0	4.5	100.0
C (Midwest)							
N	2	23	132	163	47	11	378
%	0.5	6.1	34.9	43.1	12.5	2.9	100.0
D (SW)							
N	2	16	99	162	89	20	388
%	0.5	4.1	25.5	41.8	22.9	5.2	100.0
E (NW)							
N	4	10	54	58	19	4	149
%	2.7	6.7	36.2	38.9	12.8	2.7	100.0
Total	10	75	410	606	265	70	1436

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Table 2. THE NUMBER AND PERCENT OF STUDY PARTICIPANTS BY U.S. REGION AND RACE

Human Milk Study 1975

Region	Race					Total
	White	Black	Am. Indian	Mexican Am.	Other *	
A (NE)						
N	212	5	0	0	16	233
%	91.0	2.1	0	0	6.9	100.0
B (SE)						
N	247	21	2	1	17	288
%	85.8	7.3	0.7	0.3	5.9	100.0
C (Midwest)						
N	326	3	2	1	46	378
%	86.2	0.8	0.5	0.3	12.2	100.0
D (SW)						
N	310	4	5	36	33	388
%	79.9	1.0	1.3	9.3	8.5	100.0
E (NW)						
N	115	4	8	4	18	149
%	77.2	2.7	5.4	2.7	12.0	100.0
Total	1210	37	17	42	130	1436

* Other includes unknown as well as other races.

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Table 3. THE NUMBER AND PERCENT OF STUDY PARTICIPANTS BY U.S. REGION AND MOTHER'S OCCUPATION

Human Milk Study 1975

Region	Occupation				Total
	Unknown	Laborer	Professional	Housewife	
A (NE)					
N	1	5	81	146	233
%	0.4	2.1	34.8	62.7	100.0
B (SE)					
N	0	15	55	218	288
%	0	5.2	19.1	75.7	100.0
C (Midwest)					
N	2	17	101	258	378
%	0.5	4.5	26.7	68.3	100.0
D (SW)					
N	5	8	106	269	388
%	1.3	2.1	27.3	69.3	100.0
E (NW)					
N	2	5	35	107	149
%	1.3	3.4	23.5	71.8	100.0
Total	10	50	378	998	1436

Tables 4-11 illustrate the number of positive samples, the range, and the mean levels of eight compounds on a fat adjusted basis. These samples are also broken down by geographic area. For example, Table 4 shows there were 231 samples positive for p,p'-DDT in the Northeast. The range for that geographic area was 46.429 - 3500.00 and the mean value was 468.202. The range for all positive samples for p,p'-DDT was from 28.871 to 34639.286.

Table 4

P,P'-DDT LEVELS IN PPB IN MILK OF NURSING MOTHERS ON A FAT ADJUSTED BASIS

Five United States Geographical Areas

Human Milk Study 1975

		Fat Adjusted Samples	
Geographical Area	Number Samples Positive	Range	Mean
Northeast	N = 231	46.429 - 3500.000	468.202
Southeast	N = 284	59.935 - 16840.106	606.915
Midwest	N = 377	42.553 - 7063.636	469.732
Southwest	N = 385	43.785 - 34639.286	704.757
Northwest	N = 148	28.871 - 2855.340	396.039

N, range, and mean include only samples with levels above the sensitivity level, 1 ppb.

Table 5

O,P-DDT LEVELS IN PPB IN MILK OF NURSING MOTHERS ON A FAT ADJUSTED BASIS

Five United States Geographical Areas

Human Milk Study 1975

	Fat Adjusted Samples		
Geographical Area	Number Samples Positive	Range	Mean
Northeast	N = 84	55.102 - 2000.000	254.402
Southeast	N = 82	10.031 - 1430.079	138.623
Midwest	N = 239	24.691 - 1428.571	173.636
Southwest	N = 83	20.040 - 1120.000	187.416
Northwest	N = 28	20.000 - 6333.333	314.600

N, range, and mean include only samples with levels above the sensitivity level, 1 ppb.

Table 6

P,P'-DDE LEVELS IN PPB IN MILK OF NURSING MOTHERS ON A FAT ADJUSTED BASIS

Five United States Geographical Areas

Human Milk Study 1975

		Fat Adjusted Samples	
Geographical Area	Number Samples Positive	Range	Mean
Northeast	N = 233	204.777 - 10115.385	2262.365
Southeast	N = 288	125.000 - 147700.000	4277.889
Midwest	N = 378	162.037 - 30945.455	2305.261
Southwest	N = 387	129.341 - 214166.667	5293.102
Northwest	N = 148	203.145 - 11068.847	2500.185

N, range, and mean include only samples with levels above the sensitivity level, 1 ppb.

Table 7

α-BHC LEVELS IN PPB IN MILK OF NURSING MOTHERS ON A FAT ADJUSTED BASIS

Five United States Geographical Areas

Human Milk Study 1975

		Fat Adjusted Samples	
Geographical Area	Number Samples Positive	Range	Mean
Northeast	N = 4	57.143 - 104.412	79.567
Southeast	N = 3	30-017 - 60.000	48.359
Midwest	N = 0	0.000 - 0.000	0.000
Southwest	N = 3	19.973 - 59.960	33.311
Northwest	N = 0	0.000 - 0.000	0.000

N, range, and mean include only samples with levels above the sensitivity level, 1 ppb.

Table 8

β-BHC LEVELS IN PPB IN MILK OF NURSING MOTHERS ON A FAT ADJUSTED BASIS

Five United States Geographical Areas

Human Milk Study 1975

		Fat Adjusted Samples	
Geographical Area	Number Samples Positive	Range	Mean
Northeast	N = 187	16.399 - 1000.000	147.152
Southeast	N = 242	19.946 - 1610.000	211.910
Midwest	N = 347	35.088 - 1333.333	157.112
Southwest	N = 350	22.599 - 9216.667	258.502
Northwest	N = 121	19.963 - 1192.275	140.756

N, range, and mean include only samples with levels above the sensitivity level, 1 ppb.

Table 9

γ-BHC LEVELS IN PPB IN MILK OF NURSING MOTHERS ON A FAT ADJUSTED BASIS

Five United States Geographical Areas

Human Milk Study 1975

		Fat Adjusted Samples	
Geographical Area	Number Samples Positive	Range	Mean
Northeast	N = 0	0.000 - 0.000	0.000
Southeast	N = 14	10.031 - 59.959	25.751
Midwest	N = 2	49.584 - 185.806	117.895
Southwest	N = 7	29.956 - 247.244	102.432
Northwest	N = 0	0.000 - 0.000	0.000

N, range, and mean include only samples with levels above the sensitivity level, 1 ppb.

Table 10

HCB LEVELS IN PPB IN MILK OF NURSING MOTHERS ON A FAT ADJUSTED BASIS

Five United States Geographical Areas

Human Milk Study 1975

		Fat Adjusted Samples	
Geographical Area	Number Samples Positive	Range	Mean
Northeast	N = 79	10.567 - 181.818	49.186
Southeast	N = 125	14.366 - 590.244	56.156
Midwest	N = 140	15.584 - 1444.444	100.791
Southwest	N = 226	15.782 - 915.789	87.859
Northwest	N = 93	13.620 - 648.069	71.525

N, range, and mean include only samples with levels above the sensitivity level, 1 ppb.

Table 11

TNC LEVELS IN PPB IN MILK OF NURSING MOTHERS ON A FAT ADJUSTED BASIS

Five United States Geographical Areas

Human Milk Study

		Fat Adjusted Samples	
Geographical Areas	Number Samples Positive	Range	Mean
Northeast	N = 152	19.231 - 514.815	79.238
Southeast	N = 233	18.333 - 1060.294	112.307
Midwest	N = 244	15.068 - 454.545	83.658
Southwest	N = 294	22.838 - 912.057	102.073
Northwest	N = 84	13.704 - 535.130	69.057

N, range, and mean include only samples with levels above the sensitivity level, 1 ppb.

In Tables 12-19, the fat adjusted levels of the eight compounds are broken down by geographic area. Within each of the areas, the compounds are broken into eight intervals: below detection, 1-50 ppb, 51-75 ppb, 76-100 ppb, 101-150 ppb, 151-250 ppb, 251-500 ppb, and >500 ppb. Within each of these intervals, the number of positive samples, the means and standard deviations are given. The zero and trace values are combined in this set of tables and the mean and the standard deviation are computed for only the positive samples. Table 12, for example, shows that there were 107 samples analyzed from the Northeast with values between 251-500 ppb of p,p'-DDT. The mean for that group of samples was 359.747 and the standard deviation was 65.445.

Table 12

FAT ADJUSTED P,P'-DDT LEVELS IN HUMAN MILK BY GEOGRAPHIC AREA

Human Milk Study 1975

		REGION					
LEVEL		Northeast	Southeast	Midwest	Southwest	Northwest	Total
Below Detection	n	2	4	1	3	1	11
1-50 ppb	n	1	0	1	3	1	6
	$\bar{x}$	46.429	0	42.553	45.007	28.871	42.146
	S.D.	0	0	0	1.601	0	6.700
51-75 ppb	n	0	1	0	4	1	6
	$\bar{x}$	0	59.935	0	64.455	70.149	64.651
	S.D.	0	0	0	5.935	0	5.627
76-100 ppb	n	2	1	4	7	2	16
	$\bar{x}$	92.996	88.333	91.882	89.812	89.309	90.572
	S.D.	2.191	0	4.316	8.776	13.166	6.962
101-150 ppb	n	14	20	15	31	9	89
	$\bar{x}$	128.717	124.861	121.985	130.363	136.523	128.079
	S.D.	17.947	13.205	16.107	15.119	11.241	15.290
151-250 ppb	n	36	52	70	81	34	273
	$\bar{x}$	207.751	205.464	213.353	198.386	204.496	205.568
	S.D.	25.057	29.381	29.730	26.236	26.000	27.983
251-500 ppb	n	107	127	186	154	74	648
	$\bar{x}$	359.747	351.440	363.618	359.474	364.747	359.736
	S.D.	65.445	67.914	72.521	72.076	76.875	70.850
>500 ppb	n	71	83	101	105	27	387
	$\bar{x}$	847.158	1378.331	913.680	1855.622	857.901	1252.804
	S.D.	473.141	2169.671	757.053	3822.897	498.382	2305.849
Totals	n	233	288	378	388	149	1436
	*$\bar{x}$	468.202	606.915	469.732	704.757	396.039	552.669
	*S.D.	373.702	1272.040	482.458	2113.197	319.732	1277.778

* - $\bar{x}$ and S.D. are computed only for levels above the sensitivity level, 1 ppb.

Table 13

FAT ADJUSTED O,P-DDT LEVELS IN HUMAN MILK BY GEOGRAPHIC AREA

Human Milk Study 1975

		REGION					
LEVEL		Northeast	Southeast	Midwest	Southwest	Northwest	Total
Below Detection	n	149	206	139	305	121	920
1-50 ppb	n	0	32	11	11	11	65
	$\bar{x}$	0	35.673	40.274	31.063	38.185	36.097
	S.D.	0	10.423	7.975	7.418	8.735	9.554
51-75 ppb	n	6	15	27	7	4	59
	$\bar{x}$	64.593	61.069	62.602	64.512	63.154	62.679
	S.D.	8.490	8.045	6.000	8.041	4.789	6.879
76-100 ppb	n	6	10	38	7	3	64
	$\bar{x}$	91.598	84.618	90.748	89.810	89.995	89.732
	S.D.	7.348	6.861	7.737	6.829	10.00	7.674
101-150 ppb	n	21	4	65	14	4	108
	$\bar{x}$	125.708	116.255	122.682	138.730	125.003	125.198
	S.D.	13.975	7.571	12.484	11.180	12.923	13.492
151-250 ppb	n	22	9	61	28	4	124
	$\bar{x}$	191.829	208.929	192.842	193.694	189.089	193.901
	S.D.	27.282	25.732	29.075	26.089	25.127	27.676
251-500 ppb	n	24	9	29	13	1	76
	$\bar{x}$	334.116	347.819	337.405	349.132	276.471	338.804
	S.D.	66.854	83.613	72.865	76.077	0	71.501
>500 ppb	n	5	3	8	3	1	20
	$\bar{x}$	1110.754	995.860	799.362	743.088	6333.333	1174.942
	S.D.	576.458	463.666	302.982	326.416	0	1277.923
Totals	n	233	288	378	388	149	1436
	*$\bar{x}$	254.402	138.623	173.636	187.416	314.600	191.086
	*S.D.	270.664	210.805	155.388	157.947	1181.360	330.394

* - $\bar{x}$ and S.D. are computed only for levels above the sensitivity level, 1 ppb.

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Table 14

FAT ADJUSTED P,P'-DDE LEVELS IN HUMAN MILK BY GEOGRAPHIC AREA
Human Milk Study 1975

		REGION					
LEVEL		Northeast	Southeast	Midwest	Southwest	Northwest	Total
Below Detection	n	0	0	0	1	1	2
1-50 ppb	n	0	0	0	0	0	0
	$\bar{x}$	0	0	0	0	0	0
	S.D.	0	0	0	0	0	0
51-75 ppb	n	0	0	0	0	0	0
	$\bar{x}$	0	0	0	0	0	0
	S.D.	0	0	0	0	0	0
76-100 ppb	n	0	0	0	0	0	0
	$\bar{x}$	0	0	0	0	0	0
	S.D.	0	0	0	0	0	0
101-150 ppb	n	0	1	0	1	0	2
	$\bar{x}$	0	125.000	0	129.341	0	127.171
	S.D.	0	0	0	0	0	3.070
151-250 ppb	n	1	0	2	1	2	6
	$\bar{x}$	204.777	0	185.670	167.500	214.003	195.271
	S.D.	0	0	33.422	0	15.356	24.902
251-500 ppb	n	11	2	11	5	1	30
	$\bar{x}$	367.099	404.412	372.499	373.942	275.204	369.644
	S.D.	62.103	122.704	70.725	90.107	0	71.369
>500 ppb	n	221	285	365	380	145	1396
	$\bar{x}$	2366.009	4319.643	2375.123	5384.905	2547.063	3607.804
	S.D.	1555.756	10357.459	2396.612	12629.493	1826.220	8313.965
Totals	n	233	288	378	388	149	1436
	*$\bar{x}$	2262.365	4277.889	2305.261	5293.102	2500.185	3520.927
	*S.D.	1579.286	10311.257	2383.984	12532.777	1836.838	8219.902

* - $\bar{x}$ and S.D. are computed only for levels above the sensitivity level, 1 ppb.

Table 15

FAT ADJUSTED α-BHC LEVELS IN HUMAN MILK BY GEOGRAPHICAL AREA
Human Milk Study 1975

		REGION					
LEVEL		North-east	South-east	Midwest	South-west	North-west	Total
Below Detection	n	229	285	378	385	149	1426
1-50 ppb	n	0	1	0	2	0	3
	$\bar{x}$	0	30.017	0	19.987	0	23.330
	S.D.	0	0	0	.019	0	5.791
51-75 ppb	n	2	2	0	1	0	5
	$\bar{x}$	65.033	57.530	0	59.960	0	61.017
	S.D.	11.158	3.493	0	0	0	6.972
76-100 ppb	n	1	0	0	0	0	1
	$\bar{x}$	83.792	0	0	0	0	83.792
	S.D.	0	0	0	0	0	0
101-150 ppb	n	1	0	0	0	0	1
	$\bar{x}$	104.412	0	0	0	0	104.412
	S.D.	0	0	0	0	0	0
151-250 ppb	n	0	0	0	0	0	0
	$\bar{x}$	0	0	0	0	0	0
	S.D.	0	0	0	0	0	0
251-500 ppb	n	0	0	0	0	0	0
	$\bar{x}$	0	0	0	0	0	0
	S.D.	0	0	0	0	0	0
>500 ppb	n	0	0	0	0	0	0
	$\bar{x}$	0	0	0	0	0	0
	S.D.	0	0	0	0	0	0
Totals	n	233	288	378	388	149	1436
	*$\bar{x}$	79.567	48.359	0	33.311	0	56.328
	*S.D.	19.850	16.076	0	23.078	0	27.293

* - $\bar{x}$ and S.D. are computed only for levels above the sensitivity level, 1 ppb.

Table 16

FAT ADJUSTED β-BHC LEVELS IN HUMAN MILK BY GEOGRAPHIC REGION
Human Milk Study 1975

LEVEL		REGION					
		Northeast	Southeast	Midwest	Southwest	Northwest	Total
Below Detection	n	46	46	31	38	28	189
1-50 ppb	n	10	12	16	27	15	80
	$\bar{x}$	37.762	38.324	43.749	40.185	39.384	40.166
	S.D.	11.361	10.297	4.716	6.604	9.547	8.256
51-75 ppb	n	35	27	49	33	24	168
	$\bar{x}$	63.096	60.030	62.267	62.998	64.366	62.524
	S.D.	8.083	8.532	6.759	7.686	6.822	7.558
76-100 ppb	n	36	33	73	33	23	198
	$\bar{x}$	87.821	89.602	88.410	87.372	86.174	88.069
	S.D.	7.635	6.804	7.817	8.145	7.470	7.627
101-150 ppb	n	46	38	99	67	31	281
	$\bar{x}$	127.197	130.984	123.360	122.693	126.734	125.232
	S.D.	14.280	13.102	14.807	14.611	14.098	14.559
151-250 ppb	n	38	67	72	95	18	290
	$\bar{x}$	180.116	198.025	193.521	188.910	190.215	191.089
	S.D.	28.930	26.582	29.602	28.711	28.051	28.780
251-500 ppb	n	17	49	29	70	7	172
	$\bar{x}$	336.235	342.111	334.007	343.391	357.963	341.330
	S.D.	69.814	70.500	74.177	72.450	70.990	71.218
>500 ppb	n	5	16	9	25	3	58
	$\bar{x}$	671.705	702.265	942.280	1368.977	1018.544	1040.610
	S.D.	197.376	295.928	259.153	1806.479	193.501	1226.166
Totals	n	233	288	378	388	149	1436
	$\bar{x}$	147.152	211.910	157.112	258.502	140.756	193.123
	S.D.	123.049	182.506	156.155	574.839	162.857	335.853

* - $\bar{x}$ and S.D. are computed only for levels above the sensitivity level, 1 ppb.

Table 17

FAT ADJUSTED γ-BHC LEVELS IN HUMAN MILK BY GEOGRAPHIC REGION
Human Milk Study 1975

LEVEL		REGION North-east	South-east	Midwest	South-west	North-west	Total
Below Detection	n	233	274	376	381	149	1413
1-50 ppb	n	0	13	1	2	0	16
	$\bar{x}$	0	23.122	49.585	29.970	0	25.632
	S.D.	0	7.605	0	0.020	0	9.617
51-75 ppb	n	0	1	0	2	0	3
	$\bar{x}$	0	59.939	0	61.516	0	60.990
	S.D.	0	0	0	2.322	0	1.877
76-100 ppb	n	0	0	0	0	0	0
	$\bar{x}$	0	0	0	0	0	0
	S.D.	0	0	0	0	0	0
101-150 ppb	n	0	0	0	1	0	1
	$\bar{x}$	0	0	0	120.144	0	120.144
	S.D.	0	0	0	0	0	0
151-250 ppb	n	0	0	1	2	0	3
	$\bar{x}$	0	0	185.807	206.955	0	199.906
	S.D.	0	0	0	56.977	0	42.098
251-500 ppb	n	0	0	0	0	0	0
	$\bar{x}$	0	0	0	0	0	0
	S.D.	0	0	0	0	0	0
>500 ppb	n	0	0	0	0	0	0
	$\bar{x}$	0	0	0	0	0	0
	S.D.	0	0	0	0	0	0
Totals	n	233	288	378	388	149	1436
	*$\bar{x}$	0	25.751	117.695	102.432	0	57.084
	*S.D.	0	12.256	96.323	80.896	0	62.517

* - $\bar{x}$ and S.D. are computed only for levels above the sensitivity level, 1 ppb.

Table 18

FAT ADJUSTED HCB LEVELS IN HUMAN MILK BY GEOGRAPHIC REGION
Human Milk Study 1975

		REGION					
LEVEL		North-east	South-east	Midwest	South-west	North-west	Total
Below Detection	n	154	163	238	162	56	773
1-50 ppb	n	55	86	82	82	51	356
	$\bar{x}$	32.934	33.749	35.474	35.645	34.212	34.523
	S.D.	10.046	9.144	8.481	8.370	9.056	8.965
51-75 ppb	n	15	23	27	65	18	148
	$\bar{x}$	60.238	58.342	59.238	61.720	63.044	60.753
	S.D.	7.255	8.402	6.227	7.104	7.960	7.359
76-100 ppb	n	3	6	7	37	10	63
	$\bar{x}$	86.474	89.573	87.232	86.894	90.102	87.676
	S.D.	12.041	8.329	9.341	8.136	8.652	8.353
101-150 ppb	n	4	3	8	25	8	48
	$\bar{x}$	137.151	124.632	120.180	123.874	123.264	124.310
	S.D.	19.784	5.889	17.820	12.847	20.891	15.500
151-250 ppb	n	2	5	6	5	4	22
	$\bar{x}$	181.385	201.401	186.777	202.406	186.019	193.025
	S.D.	0.612	25.121	26.439	26.462	36.992	26.203
251-500 ppb	n	0	1	4	9	1	15
	$\bar{x}$	0	266.667	353.607	350.784	492.910	355.404
	S.D.	0	0	77.702	75.800	0	80.651
>500 ppb	n	0	1	6	3	1	11
	$\bar{x}$	0	590.244	915.875	813.491	648.069	834.004
	S.D.	0	0	410.287	89.212	0	315.129
Totals	n	233	288	378	388	149	1436
	$\bar{x}$	49.186	56.156	100.791	87.859	71.525	77.713
	S.D.	34.731	64.176	199.997	108.480	85.502	121.102

* - $\bar{x}$ and S.D. are computed only for levels above the sensitivity level, 1 ppb.

Table 19

FAT ADJUSTED TNC LEVELS IN HUMAN MILK BY GEOGRAPHIC REGION
Human Milk Study 1975

		REGION					
LEVEL		North-east	South-east	Midwest	South-west	North-west	Total
Below Detection	n	81	55	134	94	65	429
1-50 ppb	n	45	38	69	57	40	249
	x̄	39.527	37.933	39.024	38.151	36.622	38.363
	S.D.	7.831	6.844	7.741	7.610	8.989	7.809
51-75 ppb	n	54	56	73	82	24	289
	x̄	61.526	62.189	62.581	62.796	61.042	62.241
	S.D.	7.511	7.805	7.256	7.561	7.467	7.486
76-100 ppb	n	24	54	45	58	9	190
	x̄	89.199	88.149	87.823	89.873	86.970	88.675
	S.D.	8.651	7.558	7.388	7.374	5.359	7.504
101-150 ppb	n	19	38	32	57	8	154
	x̄	117.548	126.187	121.986	119.193	121.287	121.405
	S.D.	12.754	13.601	13.584	15.309	14.306	14.346
151-250 ppb	n	6	32	20	27	0	85
	x̄	183.049	179.620	185.512	189.389	0	184.352
	S.D.	25.509	26.554	27.218	26.218	0	26.390
251-500 ppb	n	3	12	5	10	2	32
	x̄	318.578	311.151	317.140	329.190	291.384	317.185
	S.D.	55.065	54.904	78.510	55.917	38.616	55.858
>500 ppb	n	1	3	0	3	1	8
	x̄	514.815	735.524	0	757.820	535.130	691.247
	S.D.	0	281.281	0	158.845	0	201.203
Totals	n	233	288	378	388	149	1436
	*x̄	79.238	112.307	83.658	102.073	69.057	93.778
	*S.D.	61.119	101.764	55.646	92.685	68.724	82.438

* - x̄ and S.D. are computed only for levels above the sensitivity level, 1 ppb.

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Tables 20-27 depict the percentage distribution of the fat adjusted levels of the eight compounds by the five geographic areas. The levels are also broken down into nine groups by the pesticide level in ppb. In Table 20, for example, 0.3 percent of the samples were zero for p,p'-DDT in the Southeast; 1.1 percent of the samples in the Southeast had trace values for p,p'-DDT giving a cumulative percent of 1.4.

Table 20

PERCENT DISTRIBUTION OF FAT ADJUSTED P,P'-DDT LEVELS BY GEOGRAPHICAL AREA

N = 1436

Human Milk Study 1975

Levels in PPB	A (NE)		B (SE)		C (Midwest)		D (SW)		E (NW)	
	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
0	0.9	0.9	0.3	0.3	0.3	0.3	0.3	0.3	0.7	0.7
Trace	0	0.9	1.1	1.4	0	0.3	0.5	0.8	0	0.7
1- 50	0.4	1.3	0	1.4	0.3	0.6	0.8	1.6	0.7	1.4
51- 75	0	1.3	0.3	1.7	0	0.6	1.0	2.6	0.7	2.1
76-100	0.9	2.2	0.3	2.0	1.1	1.7	1.8	4.4	1.3	3.4
101-150	6.0	8.2	6.9	8.9	4.0	5.7	8.0	12.4	6.0	9.4
151-250	15.5	23.7	18.1	27.0	18.5	24.2	20.9	33.3	22.8	32.2
251-500	45.9	69.6	44.1	71.1	49.2	73.4	39.7	73.0	49.7	81.9
>500	30.4	100.0	28.9	100.0	26.6	100.0	27.0	100.0	18.1	100.0

Table 21

PERCENT DISTRIBUTION OF FAT ADJUSTED O,P - DDT LEVELS BY GEOGRAPHICAL AREA
N = 1436

Human Milk Study 1975

Levels	A (NE)		B (SE)		C (Midwest)		D (SW)		E (NW)	
in PPB	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
0	63.9	63.9	58.7	58.7	36.0	36.0	72.9	72.9	78.5	78.5
Trace	0	63.9	12.8	71.5	0.8	36.8	5.7	78.6	2.7	81.2
1- 50	0	63.9	11.1	82.6	2.9	39.7	2.8	81.4	7.4	88.6
51- 75	2.6	66.5	5.2	87.8	7.1	46.8	1.8	83.2	2.7	91.3
76-100	2.6	69.1	3.5	91.3	10.1	56.9	1.8	85.0	2.0	93.3
101-150	9.0	78.1	1.4	92.7	17.2	74.1	3.6	88.6	2.7	96.0
151-250	9.4	87.5	3.1	95.8	16.1	90.2	7.2	95.8	2.7	98.7
251-500	10.3	97.8	3.1	98.9	7.7	97.9	3.4	99.2	0.7	99.4
>500	2.2	100.0	1.1	100.0	2.1	100.0	0.8	100.0	0.6	100.0

Table 22

PERCENT DISTRIBUTION OF FAT ADJUSTED P,P'-DDE LEVELS BY GEOGRAPHICAL AREA
N = 1436

Human Milk Study 1975

Levels in PPB	A (NE)		B (SE)		C (Midwest)		D (SW)		E (NW)	
	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
0	0	0	0	0	0	0	0.3	0.3	0.7	0.7
Trace	0	0	0	0	0	0	0	0.3	0	0.7
1- 50	0	0	0	0	0	0	0	0.3	0	0.7
51- 75	0	0	0	0	0	0	0	0.3	0	0.7
76-100	0	0	0	0	0	0	0	0.3	0	0.7
101-150	0	0	0.3	0.3	0	0	0.3	0.6	0	0.7
151-250	0.4	0.4	0	0.3	0.5	0.5	0.3	0.9	1.3	2.0
251-500	4.7	5.1	0.7	1.0	2.9	3.4	1.3	2.2	0.7	2.7
>500	94.9	100.0	99.0	100.0	96.6	100.0	97.8	100.0	97.3	100.0

Table 23

PERCENT DISTRIBUTION OF FAT ADJUSTED α-BHC LEVELS BY GEOGRAPHICAL AREA
N = 1436

Human Milk Study 1975

Levels	A (NE)		B (SE)		C (Midwest)		D (SW)		E (NW)	
in PPB	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
0	97.0	97.0	49.7	49.7	99.7	99.7	86.6	86.6	83.2	83.2
Trace	1.3	98.3	49.3	99.0	0.3	100.0	12.6	99.2	16.8	100.0
1- 50	0	98.3	0.3	99.3	0	100.0	0.5	99.7	0	100.0
51- 75	0.9	99.2	0.7	100.0	0	100.0	0.3	100.0	0	100.0
76-100	0.4	99.6	0	100.0	0	100.0	0	100.0	0	100.0
101-150	0.4	100.0	0	100.0	0	100.0	0	100.0	0	100.0
151-250	0	100.0	0	100.0	0	100.0	0	100.0	0	100.0
251-500	0	100.0	0	100.0	0	100.0	0	100.0	0	100.0
>500	0	100.0	0	100.0	0	100.0	0	100.0	0	100.0

Table 24

PERCENT DISTRIBUTION OF FAT ADJUSTED β-BHC LEVELS BY GEOGRAPHICAL AREA
N = 1436

Human Milk Study 1975

Levels	A (NE)		B (SE)		C (Midwest)		D (SW)		E (NW)	
in PPB	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
0	8.2	8.2	10.4	10.4	3.4	3.4	2.3	2.3	11.4	11.4
Trace	11.6	19.8	5.6	16.0	4.8	8.2	7.5	9.8	7.4	18.8
1- 50	4.3	24.1	4.2	20.2	4.2	12.4	7.0	16.8	10.1	28.9
51- 75	15.0	39.1	9.4	29.6	13.0	25.4	8.5	25.3	16.1	45.0
76-100	15.5	54.6	11.4	41.0	19.3	44.7	8.5	33.8	15.4	60.4
101-150	19.7	74.3	13.2	54.2	26.2	70.9	17.3	51.1	20.8	81.2
151-250	16.3	90.6	23.3	77.5	19.0	89.9	24.5	75.6	12.1	93.3
251-500	7.3	97.9	17.0	94.5	7.7	97.6	18.0	93.6	4.7	98.0
>500	2.1	100.0	5.5	100.0	2.4	100.0	6.4	100.0	2.0	100.0

Table 25

PERCENT DISTRIBUTION OF FAT ADJUSTED γ-BHC LEVELS BY GEOGRAPHICAL AREA
N = 1436

Human Milk Study 1975

Levels	A (NE)		B (SE)		C (Midwest)		D (SW)		E (NW)	
in PPB	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
0	99.6	99.6	50.0	50.0	97.9	97.9	89.9	89.9	79.9	79.9
Trace	0.4	100.0	45.1	95.1	1.6	99.5	8.2	98.1	20.1	100.0
1- 50	0	100.0	4.5	99.6	0.3	99.8	0.5	98.6	0	100.0
51- 75	0	100.0	0.4	100.0	0	99.8	0.5	99.1	0	100.0
76-100	0	100.0	0	100.0	0	99.8	0	99.1	0	100.0
101-150	0	100.0	0	100.0	0	99.8	0.3	99.4	0	100.0
151-250	0	100.0	0	100.0	0.2	100.0	0.6	100.0	0	100.0
251-500	0	100.0	0	100.0	0	100.0	0	100.0	0	100.0
>500	0	100.0	0	100.0	0	100.0	0	100.0	0	100.0

Table 26

PERCENT DISTRIBUTION OF FAT ADJUSTED HCB LEVELS BY GEOGRAPHICAL AREA
N = 1436

Human Milk Study 1975

Levels	A (NE)		B (SE)		C (Midwest)		D (SW)		E (NW)	
in PPB	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
0	0	0	4.5	4.5	7.7	7.7	4.1	4.1	11.4	11.4
Trace	66.1	66.1	52.1	56.6	55.3	63.0	37.6	41.7	26.2	37.6
1- 50	23.6	89.7	29.9	86.5	21.7	84.7	21.1	62.8	34.2	71.8
51- 75	6.4	96.1	8.0	94.5	7.1	91.8	16.8	79.6	12.1	89.9
76-100	1.3	97.4	2.1	96.6	1.9	93.7	9.5	89.1	6.7	90.6
101-150	1.7	99.1	1.0	97.6	2.1	95.8	6.4	95.5	5.4	96.0
151-250	0.9	100.0	1.7	99.3	1.6	97.4	1.3	96.8	2.7	98.7
251-500	0	100.0	0.3	99.6	1.1	98.5	2.3	99.1	0.7	99.4
>500	0	100.0	0.4	100.0	1.5	100.0	0.9	100.0	0.6	100.0

Table 27

PERCENT DISTRIBUTION OF FAT ADJUSTED TNC LEVELS BY GEOGRAPHICAL AREA

N = 1436

Human Milk Study 1975

Levels	A (NE)		B (SE)		C (Midwest)		D (SW)		E (NW)	
in PPB	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
0	2.6	2.6	7.6	7.6	5.6	5.6	4.9	4.9	18.1	18.1
Trace	32.2	34.8	11.5	19.1	29.9	35.5	19.3	24.2	25.5	43.6
1- 50	19.3	54.1	13.2	32.3	18.3	53.8	14.7	38.9	26.8	70.4
51- 75	23.2	77.3	19.4	51.7	19.3	73.1	21.1	60.0	16.1	86.5
76-100	10.3	87.6	18.8	70.5	11.9	85.0	14.9	74.9	6.0	92.5
101-150	8.2	95.8	13.2	83.7	8.5	93.5	14.7	89.6	5.4	97.9
151-250	2.6	98.4	11.1	94.8	5.3	98.8	7.0	96.6	0	97.9
251-500	1.3	99.7	4.2	99.0	1.2	100.0	2.6	99.2	1.3	99.2
>500	0.3	100.0	1.0	100.0	0	100.0	0.8	100.0	0.8	100.0

Tables 28-35 show the percentage distribution of the eight compounds for urban and rural areas. The compounds are also broken down into nine groups by the pesticide level. Since thirty-six of the participants in the study didn't respond to the urban-rural question, they were not included in this tabulation. According to Table 28, 44.4 percent of the samples taken in the urban area had fat adjusted levels of p,p'-DDT between 251-500 ppb, while 50.5 percent of the samples taken in the rural area had fat adjusted levels of p,p'-DDT between 251-500 ppb.

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Table 28

PERCENT DISTRIBUTION OF FAT ADJUSTED P,P'-DDT LEVELS BY URBAN-RURAL AREAS. N = 1400*

Human Milk Study 1975

Levels in PPB	Urban		Rural	
	%	Cum %	%	Cum %
0	0.5	0.5	0	0
Trace	0.3	0.8	0	0
1- 50	0.4	1.2	0.5	0.5
51- 75	0.5	1.7	0	0.5
76-100	1.3	3.0	0	0.5
101-150	5.9	8.9	8.3	8.8
151-250	19.8	28.7	15.0	23.8
251-500	44.4	73.1	50.5	74.3
>500	26.9	100.0	25.7	100.0

*Urban-rural classification not coded for 36 participants.

Table 29

PERCENT DISTRIBUTION OF FAT ADJUSTED O,P-DDT LEVELS BY URBAN-RURAL AREAS. N = 1400*
Human Milk Study 1975

Levels in PPB	Urban		Rural	
	%	Cum %	%	Cum %
0	61.2	61.2	52.4	52.4
Trace	4.5	65.7	3.4	55.8
1- 50	3.9	69.6	7.8	63.6
51- 75	3.9	73.5	5.3	68.9
76-100	3.9	77.4	7.8	76.7
101-150	7.7	85.1	7.8	84.5
151-250	8.2	93.3	9.7	94.2
251-500	5.4	98.7	4.4	98.6
>500	1.3	100.0	1.4	100.0

*Urban-rural classification not coded for 36 participants.

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Table 30

PERCENT DISTRIBUTION OF FAT ADJUSTED P,P'-DDE LEVELS BY URBAN-RURAL AREAS. N = 1400*

Human Milk Study 1975

Levels in PPB	Urban		Rural	
	%	Cum %	%	Cum %
0	0.2	0.2	0	0
Trace	0	0.2	0	0
1- 50	0	0.2	0	0
51- 75	0	0.2	0	0
76-100	0	0.2	0	0
101-150	0.2	0.4	0	0
151-250	0.5	0.9	0	0
251-500	2.1	3.1	1.0	1.0
>500	96.9	100.0	99.0	100.0

*Urban-rural classification not coded for 36 participants.

Table 31

PERCENT DISTRIBUTION OF FAT ADJUSTED α-BHC LEVELS BY URBAN-RURAL AREAS. N = 1400*

Human Milk Study 1975

Levels in PPB	Urban		Rural	
	%	Cum %	%	Cum %
0	84.8	84.8	81.0	81.0
Trace	14.6	99.4	18.0	99.0
1- 50	0.1	99.5	1.0	100.0
51- 75	0.3	99.8	0	100.0
76-100	0.1	99.9	0	100.0
101-150	0.1	100.0	0	100.0
151-250	0	100.0	0	100.0
251-500	0	100.0	0	100.0
>500	0	100.0	0	100.0

*Urban-Rural classification not coded for 36 participants.

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Table 32

PERCENT DISTRIBUTION OF FAT ADJUSTED β-BHC LEVELS BY URBAN-RURAL AREAS. N = 1400*

Human Milk Study 1975

Levels	Urban		Rural	
in PPB	%	Cum %	%	Cum %
0	5.9	5.9	7.8	7.8
Trace	7.6	13.5	2.9	10.7
1- 50	4.8	18.3	9.2	19.9
51- 75	11.6	29.9	13.6	33.5
76-100	14.2	44.1	12.6	46.1
101-150	19.3	63.4	21.4	67.5
151-250	20.5	83.9	18.9	86.4
251-500	12.2	96.1	9.7	96.1
>500	3.9	100.0	3.9	100.0

*Urban-rural classification not coded for 36 participants.

Table 33

PERCENT DISTRIBUTION OF FAT ADJUSTED γ-BHC LEVELS BY URBAN-RURAL AREAS. N = 1400*

Human Milk Study 1975

Levels	Urban		Rural	
in PPB	%	Cum %	%	Cum %
0	85.5	85.5	79.6	79.6
Trace	13.0	98.5	18.5	98.1
1- 50	1.0	99.5	1.9	100.0
51- 75	0.2	99.7	0	100.0
76-100	0	99.7	0	100.0
101-150	0.1	99.8	0	100.0
151-250	0.2	100.0	0	100.0
251-500	0	100.0	0	100.0
>500	0	100.0	0	100.0

*Urban-rural classification not coded for 36 participants.

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Table 34

PERCENT DISTRIBUTION OF FAT ADJUSTED HBC LEVELS BY URBAN-RURAL AREAS. N = 1400*

Human Milk Study 1975

Levels in PP	Urban %	Urban Cum %	Rural %	Rural Cum %
0	4.7	4.7	7.8	7.8
Trace	48.9	53.6	48.5	56.3
1- 50	24.0	77.6	29.1	85.4
51- 75	10.6	88.2	8.3	93.7
76-100	4.7	92.9	1.5	95.2
101-150	3.5	96.4	2.4	97.6
151-250	1.6	98.0	1.4	99.0
251-500	1.0	99.0	1.0	100.0
>500	1.0	100.0	0	100.0

*Urban-rural classification not coded for 36 participants.

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Table 35

PERCENT DISTRIBUTION OF FAT ADJUSTED TNC LEVELS BY URBAN-RURAL AREAS. N = 1400*

Human Milk Study 1975

Levels in PPB	Urban		Rural	
	%	Cum %	%	Cum %
0	6.0	6.0	10.7	10.7
Trace	23.1	29.1	23.3	34.0
1- 50	16.9	46.0	18.9	52.9
51- 75	21.2	67.2	15.5	68.4
76-100	13.1	80.3	14.6	83.0
101-150	10.7	91.0	10.2	93.2
151-250	6.2	97.2	3.9	97.1
251-500	2.3	99.5	1.9	99.0
>500	0.5	100.0	1.0	100.0

*Urban-rural classification not coded for 36 participants.

Tables 36-43 show the distribution of the fat adjusted levels of the eight compounds for each race. The largest number of samples (1210) were given by white women followed by Mexican Americans (42), Blacks (37), and American Indians (17). The column labeled "Other" includes all other races as well as any mothers that didn't give their race. Table 36, for example, shows that 46.8 percent of the white mothers had levels of p,p'-DDT between 251-500 ppb while only 21.6 percent of the black mothers were in this category.

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Table 36

PERCENT DISTRIBUTION OF FAT ADJUSTED LEVELS P,P'-DDT LEVELS BY RACE. N = 1436
Human Milk Study 1975

Levels	White N=1210		Black N=37		Mexican Am. N=42		Am. Indian N=17		Other* N=130	
in PPB	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
0	0.5	0.5	0	0	0	0	0	0	0	0
Trace	0.2	0.7	0	0	0	0	5.9	5.9	0.8	0.8
1- 50	0.5	1.2	0	0	0	0	0	5.9	0	0.8
51- 75	0.5	1.7	0	0	0	0	0	5.9	0	0.8
76-100	1.1	2.8	0	0	0	0	0	5.9	2.3	3.1
101-150	6.8	9.6	0	0	2.4	2.4	0	5.9	4.6	7.7
151-250	20.0	29.6	13.5	13.5	4.8	7.2	17.6	23.5	16.2	23.9
251-500	46.8	76.4	21.6	35.1	19.0	26.2	35.3	58.8	46.1	70.0
>500	23.6	100.0	64.9	100.0	73.8	100.0	41.2	100.0	30.0	100.0

* Other includes unknown as well as other races.

Table 37

PERCENT DISTRIBUTION OF FAT ADJUSTED LEVELS O,P-DDT LEVELS BY RACE. N = 1436

Human Milk Study 1975

Levels	White N=1210		Black N=37		Mexican Am. N=42		Am. Indian N=17		Other* N=130	
in PPB	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
0	60.9	60.9	37.8	37.8	76.2	76.2	88.2	88.2	43.1	43.1
Trace	5.0	65.9	0	37.8	2.4	78.6	0	88.2	3.1	46.2
1- 50	4.2	70.1	13.5	51.3	2.4	81.0	0	88.2	6.2	52.4
51- 75	3.6	73.7	18.9	70.2	4.8	85.8	0	88.2	5.4	57.8
76-100	4.3	78.0	10.8	81.0	0	85.8	5.9	94.1	5.4	63.2
101-150	7.1	85.1	2.7	83.7	7.1	92.9	0	94.1	13.8	77.0
151-250	7.9	93.0	5.4	89.1	7.1	100.0	5.9	100.0	16.9	93.9
251-500	5.5	98.5	5.4	94.5	0	100.0	0	100.0	6.1	100.0
>500	1.5	100.0	5.5	100.0	0	100.0	0	100.0	0	100.0

* Other includes unknown as well as other races.

Table 38

PERCENT DISTRIBUTION OF FAT ADJUSTED LEVELS P,P'-DDE LEVELS BY RACE. N = 1436

Human Milk Study 1975

Levels in PPB	White N=1210 %	White N=1210 Cum %	Black N=37 %	Black N=37 Cum %	Mexican Am. N=42 %	Mexican Am. N=42 Cum %	Am. Indian N=17 %	Am. Indian N=17 Cum %	Other* N=130 %	Other* N=130 Cum %
0	0.2	0.2	0	0	0	0	0	0	0	0
Trace	0	0.2	0	0	0	0	0	0	0	0
1- 50	0	0.2	0	0	0	0	0	0	0	0
51- 75	0	0.2	0	0	0	0	0	0	0	0
76-100	0	0.2	0	0	0	0	0	0	0	0
101-150	0.2	0.4	0	0	0	0	0	0	0	0
151-250	0.5	0.9	0	0	0	0	0	0	0	0
251-500	2.1	3.1	0	0	0	0	0	0	1.5	1.5
>500	96.9	100.0	100.0	100.0	100.0	100.0	100.0	100.0	98.5	100.0

* Other includes unknown as well as other races.

Table 39

PERCENT DISTRIBUTION OF FAT ADJUSTED LEVELS α-BHC LEVELS BY RACE. N = 1436

Human Milk Study 1975

Levels	White N=1210		Black N=37		Mexican Am. N=42		Am. Indian N=17		Other* N=130	
in PPB	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
0	83.6	83.6	45.9	45.9	95.2	95.2	100.0	100.0	92.3	92.3
Trace	15.6	99.2	54.1	100.0	2.4	97.6	0	100.0	7.7	100.0
1- 50	0.2	99.4	0	100.0	2.4	100.0	0	100.0	0	100.0
51- 75	0.4	99.8	0	100.0	0	100.0	0	100.0	0	100.0
76-100	0.1	99.9	0	100.0	0	100.0	0	100.0	0	100.0
101-150	0.1	100.0	0	100.0	0	100.0	0	100.0	0	100.0
151-250	0	100.0	0	100.0	0	100.0	0	100.0	0	100.0
251-500	0	100.0	0	100.0	0	100.0	0	100.0	0	100.0
>500	0	100.0	0	100.0	0	100.0	0	100.0	0	100.0

* Other includes unknown as well as other races.

Table 40

PERCENT DISTRIBUTION OF FAT ADJUSTED LEVELS β-BHC LEVELS BY RACE. N = 1436

Human Milk Study 1975

Levels	White N=1210		Black N=37		Mexican Am. N=42		Am. Indian N=17		Other* N=130	
in PPB	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
0	6.6	6.6	8.1	8.1	2.4	2.4	11.8	11.8	1.5	1.5
Trace	7.4	14.0	2.7	10.8	7.1	9.5	5.9	17.7	5.4	6.9
1- 50	5.5	19.5	10.8	21.6	2.4	11.9	5.9	23.6	6.2	13.1
51- 75	11.8	31.3	10.8	32.4	7.1	19.0	5.9	29.5	13.1	26.2
76-100	13.8	45.1	16.2	48.6	2.4	21.4	23.5	53.0	15.4	41.6
101-150	20.2	65.3	16.2	64.8	9.5	30.9	17.6	70.6	18.5	60.1
151-250	20.2	85.5	18.9	83.7	14.3	45.2	23.5	94.1	22.3	82.4
251-500	11.2	96.7	10.8	94.5	35.7	80.9	5.9	100.0	12.3	94.7
>500	3.3	100.0	5.5	100.0	19.1	100.0	0,0	100.0	5.3	100.0

* Other includes unknown as well as other races.

Table 41

PERCENT DISTRIBUTION OF FAT ADJUSTED LEVELS γ-BHC LEVELS BY RACE. N = 1436
Human Milk Study 1975

Levels	White N=1210		Black N=37		Mexican Am. N=42		Am. Indian N=17		Other* N=130	
in PPB	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
0	84.1	84.1	45.9	45.9	97.6	97.6	100.0	100.0	93.1	93.1
Trace	14.5	98.6	40.5	86.4	2.4	100.0	0	100.0	6.1	99.2
1- 50	0.8	99.4	13.6	100.0	0	100.0	0	100.0	0.8	100.0
51- 75	0.2	99.6	0	100.0	0	100.0	0	100.0	0	100.0
76-100	0	99.6	0	100.0	0	100.0	0	100.0	0	100.0
101-150	0.1	99.7	0	100.0	0	100.0	0	100.0	0	100.0
151-250	0.3	100.0	0	100.0	0	100.0	0	100.0	0	100.0
251-500	0	100.0	0	100.0	0	100.0	0	100.0	0	100.0
>500	0	100.0	0	100.0	0	100.0	0	100.0	0	100.0

* Other includes unknown as well as other races.

Table 42

PERCENT DISTRIBUTION OF FAT ADJUSTED LEVELS HCB LEVELS BY RACE. N = 1436

Human Milk Study 1975

Levels	White N=1210		Black N=37		Mexican Am. N=42		Am. Indian N=17		Other* N=130	
in PPB	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
0	5.5	5.5	2.7	2.7	2.4	2.4	5.9	5.9	3.8	3.8
Trace	48.4	53.9	37.8	40.5	50.0	52.4	23.5	29.4	56.2	60.0
1- 50	25.2	79.1	45.9	86.4	16.7	69.1	11.8	41.2	19.2	79.2
51- 75	10.3	89.4	10.8	97.2	14.3	83.4	17.6	58.8	7.7	86.9
76-100	4.0	93.4	2.8	100.0	7.1	90.5	23.5	82.3	5.4	92.3
101-150	3.4	96.8	0	100.0	2.4	92.9	11.8	94.1	3.1	95.4
151-250	1.3	98.1	0	100.0	2.4	95.3	5.9	100.0	3.1	98.5
251-500	1.2	99.3	0	100.0	2.4	97.7	0	100.0	0	98.5
>500	0.7	100.0	0	100.0	2.3	100.0	0	100.0	1.5	100.0

* Other includes unknown as well as other races.

Table 43

PERCENT DISTRIBUTION OF FAT ADJUSTED LEVELS TNC LEVELS BY RACE. N = 1436

Human Milk Study 1975

Levels	White N=1210		Black N=37		Mexican Am. N=42		Am. Indian N=17		Other* N=130	
in PPB	%	Cum %	%	Cum %	%	Cum %	%	Cum %	%	Cum %
0	7.1	7.1	0	0	4.8	4.8	11.8	11.8	3.8	3.8
Trace	22.8	29.9	8.1	8.1	31.0	35.8	23.5	35.3	29.2	33.0
1- 50	18.3	48.2	5.4	13.5	4.8	40.6	11.8	47.1	16.2	49.2
51- 75	20.7	68.9	18.9	32.4	7.1	47.7	17.6	64.7	19.2	68.4
76-100	12.7	81.6	27.0	59.4	2.4	50.1	17.6	82.3	16.9	85.3
101-150	10.0	91.6	21.6	81.0	19.0	69.1	17.7	100.0	10.8	96.1
151-250	5.6	97.2	16.2	97.2	19.0	88.1	0	100.0	3.1	99.2
251-500	2.2	99.4	2.8	100.0	7.1	95.2	0	100.0	0.8	100.0
>500	0.6	100.0	0	100.0	4.8	100.0	0	100.0	0	100.0

* Other includes unknown as well as other races.

The number, the mean, and the standard deviation for the eight compounds by the number of children previously breastfed are given in Tables 44-51. Although the samples are broken down into eight groups by pesticide level, the means and standard deviations are computed only for samples with pesticide levels above the sensitivity limit for each compound. Table 44, for example, shows that in the group of mothers who had previously nursed only one child, 211 of the mothers had pesticide levels between 251-500 ppb. The mean for that same group was 367.017 and the standard deviation was 74.991.

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Table 44

P,P'-DDT LEVELS IN MILK OF NURSING MOTHERS BY NUMBER OF SIBLINGS PREVIOUSLY BREASTFED. N = 1436

Fat Adjusted Levels

Human Milk Study 1975

P,P'-DDT Levels in PPB		Number of Siblings Previously Breastfed									
		0	1	2	3	4	5	6	7	8	10	Row Total
0	N=	1	2	1	1	0	0	1	0	0	0	6
Trace	N=	1	2	0	2	0	0	0	0	0	0	5
1- 50	X=	42.553	40.036	45.107	0	0	0	0	0	0	0	42.146
	N=	1	3	2	0	0	0	0	0	0	0	6
	SD=	0	9.744	1.869	0	0	0	0	0	0	0	6.700
51- 75	X=	0	66.220	65.014	62.717	0	0	0	0	0	0	64.651
	N=	0	2	2	2	0	0	0	0	0	0	6
	SD=	0	8.797	7.263	3.935	0	0	0	0	0	0	5.626
76-100	X=	91.994	90.794	0	86.812	0	0	0	0	0	0	90.572
	N=	7	6	0	3	0	0	0	0	0	0	16
	SD=	6.725	8.040	0	6.145	0	0	0	0	0	0	6.962
101-150	X=	130.144	127.100	127.448	124.618	118.686	140.000	0	116.279	0	0	128.079
	N=	35	31	15	4	2	1	0	1	0	0	89
	SD=	14.719	16.791	15.202	14.950	12.396	0	0	0	0	0	15.290
151-250	X=	202.906	206.252	208.850	204.334	220.231	212.526	184.301	205.128	0	184.960	205.568
	N=	102	95	52	13	5	3	1	1	0	1	273
	SD=	28.314	29.272	25.594	28.924	27.058	28.851	0	0	0	0	27.983
251-500	X=	357.116	367.017	355.101	346.713	351.704	413.075	0	361.860	0	0	359.736
	N=	317	211	78	28	11	2	0	1	0	0	648
	SD=	70.567	74.991	62.965	61.122	75.086	67.177	0	0	0	0	70.850
>500	X=	1389.721	963.901	1211.480	1358.911	821.845	0	3812.390	733.610	1890.219	516.241	1252.803
	N=	200	111	44	18	6	0	3	2	2	1	387
	SD=	3032.283	750.008	1428.579	1379.496	473.065	0	917.397	36.218	1357.566	0	2305.849
Column Total	*X=	630.042	454.826	487.022	554.545	422.431	267.288	2905.367	430.098	1890.219	350.601	552.669
	N=	662	459	193	68	24	6	4	5	2	2	1436
	*SD=	1739.537	477.331	788.123	853.371	334.896	121.560	1962.609	291.248	1357.566	234.251	1277.778

* - $\bar{X}$ and SD are computed only for levels above the sensitivity level, 1 ppb.

Table 45

O,P-DDT LEVELS IN MILK OF NURSING MOTHERS BY NUMBER OF SIBLINGS PREVIOUSLY BREASTFED. N = 1436
Fat Adjusted Levels
Human Milk Study 1975

O,P-DDT Levels in PPB		Number of Siblings Previously Breastfed										Row Total
		0	1	2	3	4	5	6	7	8	10	
0	N=	415	278	101	36	15	1	2	4	1	1	854
Trace	N=	30	23	11	2	0	0	0	0	0	0	66
1- 50	X=	37.094	35.687	35.370	32.101	20.040	50.000	0	0	0	0	36.097
	N=	30	19	11	3	1	1	0	0	0	0	65
	SD=	9.130	9.408	10.848	7.636	0	0	0	0	0	0	9.554
51- 75	X=	63.274	63.818	61.019	55.556	62.440	0	50.093	0	0	70.070	62.679
	N=	33	10	11	1	2	0	1	0	0	1	59
	SX=	6.369	7.459	7.143	0	10.812	0	0	0	0	0	6.879
76-100	X=	89.305	93.119	87.236	92.576	85.869	87.667	0	80.000	80.130	0	89.732
	N=	17	16	15	9	3	2	0	1	1	0	64
	SX=	7.929	7.356	7.947	6.837	1.338	6.128	0	0	0	0	7.674
101-150	X=	123.229	126.343	128.272	125.540	135.714	123.726	0	102.564	0	0	125.198
	N=	46	33	18	6	2	2	0	1	0	0	108
	SX=	13.699	12.114	13.873	16.408	10.102	22.087	0	0	0	0	13.492
151-250	X=	189.096	201.002	191.829	190.672	0	0	0	0	0	0	193.901
	N=	49	44	20	11	0	0	0	0	0	0	124
	SD=	27.410	27.316	24.813	32.882	0	0	0	0	0	0	27.676
251-500	X=	356.010	326.134	341.188	279.167	291.667	0	0	0	0	0	338.804
	N=	33	33	7	2	1	0	0	0	0	0	76
	SD=	75.265	67.064	75.003	5.893	0	0	0	0	0	0	71.501
>500	X=	1548.081	759.320	0	600.000	0	0	554.717	0	0	0	1174.942
	N=	11	7	0	1	0	0	1	0	0	0	20
	SD=	1651.508	222.817	0	0	0	0	0	0	0	0	1277.923
Column Total	*X=	221.144	196.896	132.959	151.334	107.291	94.557	302.405	91.282	80.130	70.070	191.086
	N=	219	162	82	33	9	5	2	2	1	1	1436
	*SD=	479.389	162.571	87.317	104.669	78.139	32.815	356.823	15.955	0	0	330.394

* - $\bar{X}$ and SD are computed only for levels above the sensitivity level, 1 ppb.

Table 46

P,P'-DDE LEVELS IN MILK OF NURSING MOTHERS BY NUMBER OF SIBLINGS PREVIOUSLY BREASTFED. N = 1436

Fat Adjusted Levels

Human Milk Study 1975

P,P'-DDE Levels in PPB		Number of Siblings Previously Breastfed										
		0	1	2	3	4	5	6	7	8	10	Row Total
0	N=	1	1	0	0	0	0	0	0	0	0	2
Trace	N=	0	0	0	0	0	0	0	0	0	0	0
1- 50	X=	0	0	0	0	0	0	0	0	0	0	0
	N=	0	0	0	0	0	0	0	0	0	0	0
	SD=	0	0	0	0	0	0	0	0	0	0	0
51- 75	X=	0	0	0	0	0	0	0	0	0	0	0
	N=	0	0	0	0	0	0	0	0	0	0	0
	SD=	0	0	0	0	0	0	0	0	0	0	0
76-100	X=	0	0	0	0	0	0	0	0	0	0	0
	N=	0	0	0	0	0	0	0	0	0	0	0
	SD=	0	0	0	0	0	0	0	0	0	0	0
101-150	X=	125.000	129.341	0	0	0	0	0	0	0	0	127.171
	N=	1	1	0	0	0	0	0	0	0	0	2
	SD=	0	0	0	0	0	0	0	0	0	0	3.070
151-250	X=	0	214.003	162.037	186.139	0	0	0	209.302	0	0	195.271
	N=	0	2	1	2	0	0	0	1	0	0	6
	SD=	0	15.356	0	26.359	0	0	0	0	0	0	24.902
251-500	X=	388.444	332.543	433.454	406.265	317.647	0	0	0	0	0	369.644
	N=	9	13	4	3	1	0	0	0	0	0	30
	SD=	55.968	69.296	44.320	86.738	0	0	0	0	0	0	71.369
>500	X=	3942.045	3056.868	2990.319	5378.994	2527.976	2360.759	16172.115	4899.394	6174.922	2474.401	3607.804
	N=	653	446	189	66	23	6	4	5	2	2	1396
	SD=	9824.479	3182.305	5200.377	18355.328	2772.827	1901.277	13253.595	4909.925	3090.075	2035.790	8313.965
Column Total	*X̄=	3888.049	2961.566	2923.021	5022.601	2435.879	2360.759	16172.115	4117.712	6174.922	2474.401	3520.927
	N=	663	462	194	71	24	6	4	6	2	2	1436
	*SD=	9759.774	3166.947	5149.342	17735.674	2749,154	1901.277	13253.595	4790.830	3090.075	2035.790	8219.902

* - X̄ and SD are computed only for levels above the senstivitiy level, 1 ppb.

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Table 47

α-BHC LEVELS IN MILK OF NURSING MOTHERS BY NUMBER OF SIBLINGS PREVIOUSLY BREASTFED. N = 1436

Fat Adjusted Levels

Human Milk Study 1975

α-BHC Levels in PPB		Number of Siblings Previously Breastfed										
		0	1	2	3	4	5	6	7	8	10	Row Total
0	N=	557	387	159	66	21	5	2	6	1	2	1206
Trace	N=	102	73	33	5	3	1	2	0	1	0	220
1- 50	X=	30.017	19.973	20.000	0	0	0	0	0	0	0	23.330
	N=	1	1	1	0	0	0	0	0	0	0	3
	SD=	0	0	0	0	0	0	0	0	0	0	5.791
51- 75	X=	61.271	60.000	0	0	0	0	0	0	0	0	61.017
	N=	4	1	0	0	0	0	0	0	0	0	5
	SD=	8.023	0	0	0	0	0	0	0	0	0	6.972
76-100	X=	0	83.792	0	0	0	0	0	0	0	0	83.792
	N=	0	1	0	0	0	0	0	0	0	0	1
	SD=	0	0	0	0	0	0	0	0	0	0	0
101-150	X=	0	0	104.412	0	0	0	0	0	0	0	104.412
	N=	0	0	1	0	0	0	0	0	0	0	1
	SD=	0	0	0	0	0	0	0	0	0	0	0
151-250	X=	0	0	0	0	0	0	0	0	0	0	0
	N=	0	0	0	0	0	0	0	0	0	0	0
	SD=	0	0	0	0	0	0	0	0	0	0	0
251-500	X=	0	0	0	0	0	0	0	0	0	0	0
	N=	0	0	0	0	0	0	0	0	0	0	0
	SD=	0	0	0	0	0	0	0	0	0	0	0
>500	X=	0	0	0	0	0	0	0	0	0	0	0
	N=	0	0	0	0	0	0	0	0	0	0	0
	SD=	0	0	0	0	0	0	0	0	0	0	0
Column Total	*X	55.020	54.589	62.206	0	0	0	0	0	0	0	56.328
	N=	664	463	194	71	24	6	4	6	2	2	1436
	*SD=	15.610	32.252	59.688	0	0	0	0	0	0	0	27.293

* - X̄ and SD are computed only for levels above the sensitivity level, 1 ppb.

Table 48

β-BHC LEVELS IN MILK OF NURSING MOTHERS BY NUMBER OF SIBLINGS PREVIOUSLY BREASTFED. N = 1436
Fat Adjusted Levels

Human Milk Study 1975

β-BHC Levels in PPB		Number of Siblings Previously Breastfed										
		0	1	2	3	4	5	6	7	8	10	Row Total
0	N=	38	23	18	6	2	0	0	1	0	0	88
Trace	N=	38	36	18	6	3	0	0	0	0	0	101
1- 50	X=	39.591	40.557	38.275	42.275	50.000	0	0	46.512	0	38.560	40.166
	N=	28	29	13	7	1	0	0	1	0	1	80
	SD=	6.630	9.444	9.492	8.043	0	0	0	0	0	0	8.256
51- 75	X=	62.987	62.136	62.822	60.514	60.571	68.130	52.473	70.698	0	0	62.524
	N=	69	55	26	7	7	2	1	1	0	0	168
	SD=	7,804	7.314	7.322	6.484	9.454	8.302	0	0	0	0	7.558
76-100	X=	89.477	86.782	88.641	86.932	81.610	86.667	0	76.923	0	0	88.069
	N=	89	58	26	17	5	2	0	1	0	0	198
	SD=	7.693	7.552	7.623	5.849	9.185	4.714	0	0	0	0	7.627
101-150	X=	125.128	124.327	127.544	128.180	129.417	128.644	0	117.731	105.505	0	125.232
	N=	126	102	37	8	4	2	0	1	1	0	281
	SD=	14.614	14.620	13.591	15.014	19.205	29.042	0	0	0	0	14.559
151-250	X=	190.563	191.985	190.768	190.699	166.667	0	207.774	164.000	210.098	195.128	191.089
	N=	145	96	31	12	1	0	2	1	1	1	290
	SD=	27.527	29.158	31.331	38.237	0	0	39.704	0	0	0	28.780
251-500	X=	340.315	336.398	345.653	384.967	0	0	0	0	0	0	341.330
	N=	102	47	17	6	0	0	0	0	0	0	172
	SD=	68.849	74.095	72.535	88.132	0	0	0	0	0	0	71.218
>500	X=	1197.399	964.157	785.560	932.353	550.862	0	540.074	0	0	0	1040.610
	N=	29	17	8	2	1	0	1	0	0	0	58
	SD=	1616.759	759.114	417.745	470.018	0	0	0	0	0	0	1226.166
Column Total	*X=	214.715	180.545	172.336	164.164	111.434	94.480	252.024	95.173	157.801	116.844	193.123
	N=	664	463	194	71	24	6	4	6	2	2	1436
	*SD=	429.665	240.700	190.157	188.037	111.990	30.919	206.790	46.222	73.960	110.710	335.853

* - $\bar{X}$ and SD are computed only for levels above the sensitivity level, 1 ppb.

Table 49

γ-BHC LEVELS IN MILK OF NURSING MOTHERS BY NUMBER OF SIBLINGS PREVIOUSLY BREASTFED. N = 1436

Fat Adjusted Levels

Human Milk Study 1975

γ-BCH Levels in PPB		Number of Siblings Previously Breastfed										
		0	1	2	3	4	5	6	7	8	10	Row Total
0	N=	559	389	163	67	21	5	1	6	1	2	1214
Trace	N=	94	64	30	4	3	1	2	0	1	0	199
1- 50	X=	23.051	31.913	0	0	0	0	20.037	0	0	0	25.632
	N=	10	5	0	0	0	0	1	0	0	0	16
	SD=	8.342	10.793	0	0	0	0	0	0	0	0	9.617
51- 75	X=	59.875	61.548	0	0	0	0	0	0	0	0	60.990
	N=	1	2	0	0	0	0	0	0	0	0	3
	SD=	0	2.276	0	0	0	0	0	0	0	0	1.877
76-100	X=	0	0	0	0	0	0	0	0	0	0	
	N=	0	0	0	0	0	0	0	0	0	0	
	SD=	0	0	0	0	0	0	0	0	0	0	
101-150	X=	0	0	120.144	0	0	0	0	0	0	0	120.144
	N=	0	0	1	0	0	0	0	0	0	0	1
	SD=	0	0	0	0	0	0	0	0	0	0	0
151-250	X=	0	199.906	0	0	0	0	0	0	0	0	199.906
	N=	0	3	0	0	0	0	0	0	0	0	3
	SD=	0	42.098	0	0	0	0	0	0	0	0	42.098
251-500	X=	0	0	0	0	0	0	0	0	0	0	0
	N=	0	0	0	0	0	0	0	0	0	0	0
	SD=	0	0	0	0	0	0	0	0	0	0	0
>500	X=	0	0	0	0	0	0	0	0	0	0	0
	N=	0	0	0	0	0	0	0	0	0	0	0
	SD=	0	0	0	0	0	0	0	0	0	0	0
Column Total	*X=	26.398	88.238	120.144	0	0	0	20.037	0	0	0	57.084
	N=	664	463	194	71	24	6	4	6	2	2	1436
	*SD=	13.635	80.769	0	0	0	0	0	0	0	0	62.517

* - $\bar{X}$ and SD are computed only for levels above the sensitivity level, 1 ppb.

Table 50

HCB LEVELS IN MILK OF NURSING MOTHERS BY NUMBER OF SIBLINGS PREVIOUSLY BREASTFED. N = 1436

Fat Adjusted Levels

Human Milk Study 1975

HCB Levels in PPB		Number of Siblings Previously Breastfed										
		0	1	2	3	4	5	6	7	8	10	Row Total
0	N=	34	20	13	5	2	0	0	1	0	0	75
Trace	N=	304	235	97	40	14	3	1	3	1	0	698
1- 50	X=	35.238	34.667	33.241	31.804	30.172	32.787	30.056	0	0	36.281	34.523
	N=	158	123	50	17	4	1	1	0	0	2	356
	SD=	8.994	9.020	8.587	9.758	9.985	0	0	0	0	8.653	8.965
51- 75	X	60.277	61.268	60.901	58.309	64.271	53.606	0	72.695	0	0	60.753
	N=	82	45	13	2	4	1	0	1	0	0	148
	SD=	7.264	7.602	7.320	10.346	5.978	0	0	0	0	0	7.359
76-100	X=	88.507	87.180	85.305	83.097	0	100.000	84.906	0	98.165	0	87.676
	N=	34	13	8	5	0	1	1	0	1	0	63
	SD=	8.219	7.967	8.567	9.687	0	0	0	0	0	0	8.353
101-150	X=	125.225	125.932	122.628	122.176	0	0	100.430	0	0	0	124.310
	N=	26	11	8	2	0	0	1	0	0	0	48
	SD=	15.984	15.509	16.112	5.435	0	0	0	0	0	0	15.500
151-250	X=	196.029	193.278	173.251	0	0	0	0	192.000	0	0	193.025
	N=	13	6	2	0	0	0	0	1	0	0	22
	SD=	25.012	33.688	18.323	0	0	0	0	0	0	0	26.203
251-500	X=	324.435	399.051	266.667	0	0	0	0	0	0	0	355.404
	N=	7	7	1	0	0	0	0	0	0	0	15
	SD=	56.659	85.518	0	0	0	0	0	0	0	0	80.651
>500	X=	914.011	631.746	897.368	0	0	0	0	0	0	0	834.004
	N=	6	3	2	0	0	0	0	0	0	0	11
	SD=	405.392	27.497	26.051	0	0	0	0	0	0	0	315.129
Column Total	*X=	83.064	73.980	77.680	50.659	47.222	62.131	71.797	132.348	98.165	36.281	77.713
	N=	664	463	194	71	24	6	4	6	2	2	1436
	*SD=	136.346	99.623	135.522	30.781	19.755	34.408	36.973	84.361	0	8.653	121.102

* - $\bar{X}$ and SD are computed only for levels above the sensitivity level, 1 ppb.

Table 51

TNC LEVELS IN MILK OF NURSING MOTHERS BY NUMBER OF SIBLINGS PREVIOUSLY BREASTFED. N = 1436
Fat Adjusted Levels

Human Milk Study 1975

TNC Levels in PPB		Number of Siblings Previously Breastfed										
		0	1	2	3	4	5	6	7	8	10	Row Total
0	N=	38	29	19	4	2	1	0	2	0	0	95
Trace	N=	139	106	53	26	5	2	1	2	0	0	334
1- 50	X=	38.500	38.634	38.036	37.395	36.471	36.066	36.989	0	0	39.200	38.363
	N=	114	78	37	11	6	1	1	0	0	1	249
	SD=	8.063	7.465	8.000	7.273	10.954	0	0	0	0	0	7.809
51- 75	X=	62.848	61.173	62.243	64.040	63.121	52.000	69.944	51.282	0	0	62.241
	N=	135	96	32	15	8	1	1	1	0	0	289
	SD=	6.991	7.539	8.019	9.077	8.840	0	0	0	0	0	7.486
76-100	X=	89.072	88.744	88.133	87.947	77.913	83.333	0	0	80.130	0	88.675
	N=	92	67	21	7	1	1	0	0	1	0	190
	SD=	7.629	7.442	7.411	7.653	0	0	0	0	0	0	7.504
101-150	X=	120.491	122.163	123.633	122.110	0	0	115.094	0	111.927	0	121.405
	N=	76	52	19	5	0	0	1	0	1	0	154
	SD=	14.794	13.333	15.782	17.356	0	0	0	0	0	0	14.346
151-250	X=	186.697	183.530	166.840	203.616	0	0	0	0	0	162.181	184.352
	N=	53	22	7	2	0	0	0	0	0	1	85
	SD=	25.705	29.433	17.897	18.456	0	0	0	0	0	0	26.390
251-500	X=	331.430	305.960	313.671	268.212	307.759	0	0	0	0	0	317.185
	N=	14	11	5	1	1	0	0	0	0	0	32
	SD=	66.422	40.942	62.915	0	0	0	0	0	0	0	55.858
>500	X=	724.000	640.741	594.737	0	569.697	0	0	912.057	0	0	691.247
	N=	3	2	1	0	1	0	0	1	0	0	8
	SD=	291.974	178.086	0	0	0	0	0	0	0	0	201.203
Column Total	*X=	96.370	91.064	89.589	79.843	98.774	57.133	74.009	481.669	96.028	100.691	93.778
	N=	664	463	194	71	24	6	4	6	2	2	1436
	*SD=	82.004	72.952	77.138	50.661	137.041	24.048	39.211	608.660	22.483	86.961	82.438

* - $\bar{X}$ and SD are computed only for levels above the sensitivity level, 1 ppb.

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